RECOVERY ACTIONS

Structure of the Recovery Actions Narrative

The recovery actions narrative consists of a hierarchical listing of actions needed to achieve the recovery of bull trout in the Olympic Peninsula Management Unit. The first tier entries represent general recovery actions under which specific (*e.g.*, second and third tier) actions appear as appropriate. Second tier entries represent general recovery actions under which more specific actions may appear. Second tier actions that do not include specific third tier actions are usually programmatic activities that are applicable across the species' range; they appear in *italic type*. These actions may or may not have third tier actions associated with them. Third tier entries are actions specific to the Olympic Peninsula Management Unit. These third tier entires appear in the implementation schedule that follows this section and are identified in the narrative outline by three levels of numerals separated by periods (*e.g.*, 2.1.1).

The Olympic Peninsula Management Unit recovery plan for bull trout should be updated or revised as recovery actions are accomplished, as environmental conditions change, and as monitoring results or additional information become available. The Olympic Peninsula Recovery Team should meet annually to review annual monitoring reports and summaries and make recommendations for revisions to the recovery plan, if appropriate. At a minimum, we anticipate the recovery plan will be revised on a 5-year basis.

Working with Federal, State, Tribal, and private entities, and in coordination with local governments, we need to secure quality habitat conditions for bull trout. These efforts should be coordinated with ongoing NOAA Fisheries and other salmon recovery actions to avoid duplication in planning and implementation.

In the Coastal-Puget Sound Distinct Population Segment, the Olympic Peninsula and Puget Sound Recovery Teams developed specific actions to remove the threats to bull trout in their respective management units. While there is general overlap for some actions between the two management units, other actions are specific to each management unit.

A summary table linking the actions (third tier actions) needed for recovery with the reasons for decline (threat categories) is provided in Appendix 3.

Recovery Actions Narrative Outline

1. Protect, restore, and maintain suitable habitat conditions for bull trout.

1.1 Maintain or improve water quality in bull trout core areas or potential core habitat.

1.1.1 Identify and improve or remove unstable or problem roads. Use existing information from State, Tribal, and U.S. Forest Service surveys and watershed analyses, and Washington State Conservation Commission Salmon and Steelhead Habitat Limiting Factors Water Resources Inventories (WSCC 1999; 2000a, b; 2001) to identify problem roads and to stabilize roads, crossings, and other sources of sediment delivery. Evaluate roads to identify sediment sources and sediment delivery points during rainstorms and spring runoff. Implement U.S. Forest Service Watershed Improvement Needs and sediment source reduction activities throughout the Dungeness, Hoh, Quinault, Queets, and Skokomish core areas. For example, water draining from roads should be directed to slope infiltration areas and not streams to reduce sediment delivery. Where information is not available for problem roads, survey all bridges, culverts, fill slopes, and unstable road sections.

Efforts should initially focus on areas where sediments are delivered to known or suspected bull trout spawning and rearing habitat and watersheds with high levels of fine sediments and high road densities, such as those found in the South Fork Skokomish River and Church Creek in the Skokomish core area, Middle Dungeness River and Pats

and Gold Creeks in the Dungeness core area, and the Upper Clearwater River basin in the Queets core area.

Other problem roads include the Queets River Road, access roads leading into the park upstream from Lake Quinault and Owl Creek, and the Upper Hoh Road in the Hoh core area.

1.1.2 Improve routine road maintenance practices. Road maintenance practices have been identified as adversely affecting bull trout habitat where maintenance occurs on roads next to streams. Improve road maintenance protocols on all roads throughout the Olympic Peninsula Management Unit to eliminate or minimize erosion and riparian damage. For example, upslope road ditches should be directed to downslope areas away from stream channels to prevent discharging into streams. Another example includes increasing monitoring and cleaning out culverts to reduce the risk of road failures during heavy rain events. Suggested areas for initial focus of efforts include roads in the Hoh, Queets, Dungeness, and Quinault core areas.

1.1.3 Implement measures to restore natural thermal regime. Assess and minimize effects on bull trout from thermal increases (nonpoint sources) negatively impacting spawning and rearing areas and migratory corridors downstream. Water diversions and reservoir releases can cause elevated stream temperatures. Water temperatures should improve within riparian reserves on U.S. Forest Service lands. Restoring riparian vegetation on State, Tribal, and private lands will improve water quality and thermal conditions in the lower watersheds. Water temperature concerns have been identified to some extent in all core areas. For example, within the Quinault core area, temperature concerns were identified in the mainstem upstream from Lake Quinault, Falls Creek, and in the lower

Cook and Elk Creek watersheds. In the Queets core area, elevated stream temperatures were reported in the lower reaches of the Clearwater, Sams, Matheny, and Salmon River watersheds. In the Dungeness core area water temperatures are elevated throughout the lower watershed.

1.1.4 Assess and reduce water quality impacts from nutrient input from human activities. Reduce introduction of nutrients from human activities throughout the Dungeness and Skokomish River watersheds and Hood Canal by improving sewage treatment technologies, stormwater management, and livestock management to minimize contaminant and nutrient loading. In the Quinault core area evaluate potential effects to bull trout from proposed artificial fertilization of Lake Quinault to increase sockeye salmon production.

1.1.5 Encourage reestablishment of marine-derived nutrients. In the Elwha and Skokomish core areas salmon migrations have been blocked by dams, resulting in a reduction in marine-derived nutrients from salmon carcasses. Dispersing hatchery salmon carcasses in these systems can help increase available marine-derived nutrients until salmon spawning escapement levels are increased.

1.1.6 Monitor water quality and meet water quality standards for temperature, nutrient loading, dissolved oxygen, instream flow, and contaminants. Implement additional water temperature monitoring on State, Tribal, and Federal lands. Identify and correct causes of elevated temperatures in bull trout migratory, spawning, and rearing habitat. Evaluate current minimum forest practice and land use regulations for effectiveness in maintaining adequate riparian shading and large conifers for future large wood recruitment into the channel. Suggested areas to initially focus efforts, identified as having water quality as rated “poor” in WSCC

(2000a, b; 2001), include several tributaries of the Quinault River, including Joe, Mounts, Boulder, Railroad, Prairie, and Ten O'Clock Creeks [Quinault core area]; the Queets core area including the lower Queets corridor, Matheny Creek, the lower Sams and Clearwater Rivers, as well as the mainstem Salmon River and South Fork Salmon River; Hoh core area including Nolan, Anderson, Elk, Winfield, Willoughby, Maple, and Owl Creeks, as well as portions of the South Fork Hoh River; Elwha core area including the area between the Elwha and Glines Canyon Dams and to the mouth of the Elwha River downstream of Elwha Dam; and Hood Canal. Temperature data for the Skokomish River was collected by the Washington Department of Ecology during the mid- to late 1990's but was not readily available to the team at this time.

Increase monitoring and enforcement of water quality standards and implement the Total Maximum Daily Load program (Washington Department of Ecology and U.S. Environmental Protection Agency). Core areas with stream segments on the 1998 Washington Department of Ecology 303(d) list of waters in the State that are impaired by pollutants (Appendix 2) include the Skokomish (fecal coliform and low instream flow), Dungeness (low instream flow), Elwha (PCB-1254 and high temperature), Hoh (Nolan Creek high temperature), and Queets (fecal coliform, high temperature, and oxygen).

1.1.7 Identify, restore, and protect groundwater and hyporheic sources. The location of bull trout spawning sites has been correlated to areas with groundwater upwellings (Baxter and Hauer 2000). Identification, protection, and where necessary, restoration of these important groundwater areas will contribute to cold water in bull trout streams. Restoring hydrologic function impacted by old railroad and road grades near tributaries in the flat coastal piedmont will

likely improve base flows and coldwater refuge areas for anadromous bull trout in the Quinault, Skokomish, Dungeness, and Hoh core areas. In all core areas, identify and protect important alluvial reaches that likely provide important flow paths for hyporheic and shallow groundwater.

In local bull trout populations and potential local populations within the Hoh, Queets, Quinault, Dungeness and Skokomish core areas, use information on groundwater sources to help determine potential bull trout distribution through correlation with groundwater inflow and to estimate location of suitable bull trout habitat in both occupied and unoccupied streams.

1.1.8 Eliminate fine sediment sources from historical roads and railroads. Identify sources of fine sediment input from historical road networks on Federal, Tribal, and State lands. Reduce and prevent erosion from identified problem locations on motorized access roads and from closed roads at trailheads. For example, in the lower Quinault core area, old logging roads, log stringer bridges, and abandoned railroad grades have been identified in several watersheds, including Boulder, Cook, Railroad, and Ten O'Clock Creeks.

1.1.9 Adopt and implement a stormwater strategy for the Dungeness watershed, the lower Elwha watershed, and Hood Canal. Stormwater should be managed in tributaries, such as Bell, Matriotti, and Siebert Creeks, in these rapidly developing areas to reduce current stormwater effects and minimize future additional effects.

1.2 Identify barriers or sites of entrainment for bull trout and implement actions to provide passage and eliminate entrainment.

1.2.1 Eliminate entrainment in diversions and ditches. Monitor and maintain screened water diversions and irrigation ditches in the Dungeness core area to reduce entrainment losses and/or eliminate unneeded diversions. Evaluate compliance with State, U.S. Fish and Wildlife Service, and NOAA Fisheries screening criteria. Where feasible and as needed, screen diversions to meet State and Federal requirements.

1.2.2 Identify diversions that block fish passage and provide fish passage where feasible. Identify diversions that may block fish passage and install appropriate fish passage structures around diversions and/or remove related migration barriers to facilitate bull trout movement. Priority core areas include the Dungeness, Quinault, and Skokomish.

In the Quinault core area, approximately 10 to 50 percent of the flows in Cook Creek are diverted through the Quinault National Fish Hatchery, and an electronic weir prevents upstream passage. Provide opportunities for passage of bull trout around the hatchery via a bypass channel and seasonal operation of the weir. In the Dungeness core area, restore fish passage in Canyon Creek past the Washington Department of Fish and Wildlife Dungeness Hatchery intake dam; dam removal is the preferred option to restore biological processes. Ensure that the collection rack at the hatchery does not block upstream movement of bull trout during their spawning migration.

1.2.3 Eliminate culvert barriers. Monitor road crossings for blockages to upstream passage and, where beneficial to native fishes, replace or improve existing culverts that impede passage.

Many road crossings consist of culverts that may act as barriers to fish movement. Culverts acting as barriers should be identified and remedied using, for example, concrete box or bottomless arched culverts, bridges, or other means. The Washington Department of Natural Resources, Washington Department of Transportation, Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service, Quinault Indian Nation, U.S. Forest Service, Olympic National Park, and several private timber companies have completed, or are currently conducting, culvert blockage inventories.

Use existing culvert inventories or conduct additional inventories if needed. Within 5 years, develop a program with schedules for barrier culvert replacement or modification to improve fish passage and ecological function of the aquatic system. Criteria for prioritizing culvert replacement should include increasing access for migratory fish and amount of suitable habitat available upstream of the culvert. Examples in the Limiting Factors Analysis (WSCC 1999; 2000a, b; 2001) of areas with culverts needing repairs or replacements include: tributaries to Lake Quinault (Higley, McCormic, and Slide Creeks), Gatton and July Creeks, the South Shore Road, and several tributaries in the lower watershed [Quinault core area]; Clearwater and Salmon Rivers and Tacoma Creek [Queets core area]; Upper Hoh Road and several roads in the lower basin, South Fork Hoh River and Nolan and Goodman Creeks [Hoh core area]; and Hot Springs Road in Griff and Madison Creeks [Elwha core area]. Refer to the Washington State Conservation Commission Limiting Factors Analysis for a detailed list of culverts needing repairs in all core areas (WSCC 1999; 2000 a,b; 2001).

1.2.4 Eliminate or modify the tidegate on the Skokomish River. Eliminate or modify the tidegate on the Skokomish River to allow significantly greater tidal flux into the estuary and lower river. Use of the salt marsh for rearing salmonids could likely be significantly improved by increasing the amount of tidal flux occurring within the estuary.

1.2.5 Restore bull trout passage over dams and other related fish passage barriers. Assess man-made barriers that eliminate upstream and downstream fish movement in the Elwha core area (proposed Glines Canyon and Elwha Dam removals), the Skokomish core area (Cushman Dams 1 and 2, Elk Creek), the Dungeness core area (Canyon Creek), and the Quinault core area (Cook Creek). Restore passage where advisable and feasible. Assess downstream passage hazards at dams that cause injury and mortality to bull trout passing through the power tunnel and/or turbines or over spillways. Screen intakes, install fish bypasses, or provide other measures to eliminate or reduce injuries and mortalities.

1.2.6 Improve instream flows. Restore connectivity and opportunities for migration by securing or improving instream flows and/or acquiring water rights. Priority streams identified to date include the Dungeness, Elwha, and lower North Fork Skokomish Rivers.

1.2.7 Improve the efficiency of the Dungeness watershed irrigation network. Commit conserved water to instream flow. Develop a water use plan to reduce dependence on shallow groundwater withdrawals.

1.3 Identify impaired stream channel and riparian areas and implement actions to restore their appropriate functions.

1.3.1 Restore and protect riparian areas. Identify degraded riparian sites and revegetate to restore shade and canopy, riparian cover, and native vegetation to improve or maintain both occupied and potentially suitable bull trout habitat. The upper basins of Olympic Peninsula Management Unit core areas are mostly within the Olympic National Park. Degraded riparian conditions are most prevalent in the middle and lower watersheds. Restoring mature conifers along streams in the lower watershed will improve water quality in areas used for foraging, migration, and overwintering by bull trout and may eventually provide suitable habitat for spawning and juvenile rearing. Areas identified in the Limiting Factors Analysis (WSCC 1999; 2000a, b; 2001) where riparian vegetation conversion to early forest seral stages[†] within forest management areas and conversion from riparian forested habitat to agricultural land have occurred, include the lower Dungeness, Quinault, Hoh, Skokomish, Queets River basins. Opportunities should be explored to reestablish coniferous and hardwood species within converted riparian zones along with specific management to maintain the existing functioning riparian zone structure. The removal of the Elwha Dams will necessitate the reestablishment of riparian vegetation along all newly formed streambank areas.

1.3.2 Identify, evaluate, and restore overwintering habitat in the mainstem rivers and tributaries. In all core areas, identify specific overwintering areas used by bull trout in the mainstem rivers, estuaries, and tributaries, and classify general overwintering habitat for use, current condition, and restoration potential. Determine where overwintering habitat areas are degraded by factors such as sediment accumulation, bedload movement, or low flows in all core areas. Implement necessary restoration activities as

described throughout this section to improve overwintering habitat.

1.3.3 Identify, evaluate, and restore important bull trout freshwater foraging waters. Identify and prioritize restoration actions for streams where bull trout forage or where bull trout occurrence may be incidental (including contributing waters having no bull trout) but restoration will contribute to recovery of the bull trout prey base. For example, priority freshwater foraging areas include resident and anadromous reaches of Brown, Church, La Bar, Pine, and Vance Creeks (Skokomish core area); Quinault River mainstem upstream from the lake, anadromous tributaries to Lake Quinault, and anadromous reaches of Cook (with passage at the hatchery), Boulder, Ten O'Clock, and Prairie Creeks (Quinault core area); the mainstem, and anadromous reaches of Matheny Creek, the Sams and Salmon Rivers, and the Upper Clearwater River (Queets core area); middle Hoh Road and Washington Department of Natural Resources lands along the mainstem and Lower South Fork Hoh River (Hoh core area); and Gold Creek (Dungeness core area).

1.3.4 Reduce stream channel degradation and aggradation. Identify streambanks susceptible to excessive mass wasting and bank failure. On Olympic National Park and Olympic National Forest lands, use road network surveys and watershed analyses to identify and map all stream reaches with actively eroding streambanks that likely result from management activities and are susceptible to excessive failure during high flow events. Identify all head-cuts[†] and incidences of mass wasting that may negatively impact riparian areas and inhibit natural stream functions. Ensure negative effects to bull trout from degraded areas are minimized. Suggested areas for initial focus of actions include the Skokomish, Dungeness, Hoh, Queets, and

Quinault core areas. Examples where aggradation and channel incision associated with a loss of woody material have been identified include Owl and Nolan Creeks on the Hoh River (Hoh core area); the Dungeness River mainstem (Dungeness core area); and Matheny Creek and the Sams River (Queets core area).

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1.3.5 Practice nonintrusive flood control and flood repair activities. Provide technical assistance to county Conservation Districts (Natural Resources Conservation Service) and private landowners to develop options for fish friendly flood-repair techniques to improve or restore channel processes benefitting bull trout or their habitat. Ensure negative effects to bull trout from ongoing flood control activities are minimized (*e.g.*, dredging, woody debris removal, channel clearing, and bank stabilization on the South Fork Skokomish and Dungeness Rivers). To restore floodplain connectivity, where feasible, prevent future armored or riprapped banks, dikes, and levies and remove existing armoring. Priority core areas include the lower Dungeness River; Hoh River; North Fork, South Fork and mainstem Skokomish Rivers; lower Elwha River; and Quinault River.

1.3.6 Reduce impacts of development in streams, floodplains and lake shores. Restore floodplain function by exploring all funding sources for acquisition of floodplains by State, County, and Federal agencies, including Federal Emergency Management Agency. Encourage local jurisdictions to apply zoning restrictions that eliminate development in floodplains and in close proximity to lakes. Avoid and minimize further development that would constrict or constrain stream channels, degrade riparian areas, negatively impact groundwater and surface water interactions, or in any other way degrade floodplain function. Restoring floodplain connectivity is a priority on

the mainstem rivers. Suggested areas to initially focus efforts include the Dungeness and Skokomish Rivers (including Lake Cushman) and Lake Quinault.

1.3.7 Reduce transportation corridor impacts on streams. Reduce impacts from the legacy of highway and railroad encroachment, channel straightening, channel relocation, and undersized bridges. Where necessary and feasible, remove existing bank armoring (bulkheads and riprap) and channel constrictions (*e.g.,* dikes and levies) associated with transportation-corridor construction. Plan and develop future transportation corridors that eliminate the need for armoring and channel constriction. Priority restoration areas include Highway 101 Skokomish River Bridge (Skokomish core area); Schoolhouse Bridge (Dungeness core area,); North and South Shore Roads and crossing at Highway 101 and Cannings Creek (Quinault core area); Highway 101 bridge crossing at the community of Queets, the Clearwater Road bridge crossing, and the Queets River Road (Queets core area); and the Highway 101 crossing at the Hoh oxbow and the Upper Hoh Road (Hoh core area). Reduce road densities on U.S. Forest Service roads to achieve the U.S. Forest Service's targets in the Dungeness and Skokomish core areas.

Relocate riparian roads and bridge constrictions out of the floodplain. Where possible, move roads out of floodplains or away from streams having local populations of bull trout or streams that have been identified as essential for reestablishing local populations of bull trout. Where roads cannot be moved, provide drainage, recontour road fill slopes, plant woody vegetation, and seed with native vegetation to prevent slumping. Add adequate surface material if needed to prevent sediment movement. Bridges that restrict channel movement can severely restrict channel function. Suggested areas for initial focus of

efforts include Upper Hoh Road (Hoh core area); throughout the mainstem Dungeness River (Dungeness core area); lower Elwha River floodplain (Elwha core area); and the access road to Olympic National Park (Quinault core area). All core areas within the Olympic Peninsula Management Unit should have floodplain roads and bridges evaluated and relocations or improvements made where necessary.

1.3.8 Improve grazing practices. Identify areas affected by unrestricted animal access in riparian areas. Develop, implement, and adaptively manage livestock grazing plans. Plans should include actions (*e.g.*, riparian fencing, off-channel watering), performance standards, and targets for floodplains, riparian vegetation, and streambanks that effectively protect bull trout habitat and water quality. Areas of focus include the South Fork, North Fork and mainstem Skokomish, lower Hoh, and lower Dungeness Rivers and tributaries.

1.3.9 Restore natural stream channel morphology[†] . Conduct stream channel restoration activities if they are likely to benefit native fish and only where similar results cannot be achieved by other less costly and intrusive means. Priority core areas include lower Dungeness and Elwha Rivers.

1.3.10 Restore instream habitat. Increase or enhance instream habitat by restoring habitat diversity. Projects should focus on the enhancement of habitat elements, such as large woody debris, logjams, and complex channels in the short-term, and restoration of processes supporting these habitat elements in the long-term. Example areas to focus efforts include Matheny, Salmon, Clearwater, and Sams drainages (Queets core area); Cook, Chow Chow, Ten O'Clock, Prairie, Boulder, Mounts, and Railroad Creeks (Quinault core area); Owl and Nolan Creeks (Hoh core area); lower

and middle mainstem Dungeness River, Gray Wolf River, and Canyon Creek (Dungeness core area); Church, Pine, Cedar, LeBar, Brown, Rock, Vance, Hunter/Weaver, Purdy, and Skobob Creeks and the mainstem Skokomish and South Fork Skokomish Rivers (Skokomish core area); and Morse and Siebert Creeks (Strait of Juan de Fuca foraging, migration, overwintering habitat) (WSCC 2000a). The systematic restructuring of the lower and middle Elwha River with large woody debris is needed to control sediments from degrading pools and spawning gravels once the dams are removed.

1.3.11 Protect riparian and channel habitat at campgrounds, trail systems, and recreation sites. Develop riparian and stream channel management plans to protect migration, spawning, and rearing habitat adjacent to trail systems, camping, and recreation sites. Relocate campgrounds out of riparian areas when necessary to avoid impacts to bull trout habitat. Restore and protect riparian and channel habitat along heavily used trails and trailheads. Priority areas include the Hoh and Skokomish core areas.

1.3.12 Restore natural sediment routing and fluvial processes. Excessive movement of bedload material has resulted in filling of pools, increased width to depth ratios, and lower base flows. Areas of focus include mainstem Skokomish and South Fork Skokomish Rivers including Vance, Church, and Brown Creeks (Skokomish core area) and lower Dungeness River (river mile 0 to river mile 11; Dungeness core area).

1.3.13 Reduce impacts associated with recreational use of the rivers. Enforce Washington Department of Fish and Wildlife Hydraulic Project Approval permits to reduce impacts associated with recreational use of the rivers, including unregulated channel dredging by recreational

miners and removal of logjams to enhance boat passage. Areas of concern include the mainstems and major tributaries of the Hoh, Queets, and Quinault Rivers.

1.3.14 Reduce riparian firewood harvest. Implement public awareness and signing campaigns or regulatory actions to reduce firewood cutting in riparian areas, especially in and around campgrounds and in the South Fork Skokomish River riparian areas.

1.4 Operate dams to minimize negative effects on bull trout in reservoirs and downstream.

1.4.1 Reduce reservoir operational impacts. Review reservoir operational concerns (water-level manipulation, minimum pool, etc.) and provide and implement operating recommendations for Cushman Reservoir and Lake Kokanee (North Fork Skokomish River, Skokomish core area) and Lake Mills and Lake Aldwell (Elwha River, Elwha core area).

1.4.2 Provide instream flow downstream from dams. Maintain or exceed established instream flows downstream from Glines Canyon and Lower Elwha Dams (Elwha River, Elwha core area), and Cushman Dams (North Fork Skokomish River, Skokomish core area).

1.5 Identify upland conditions negatively affecting bull trout habitats and implement actions to restore appropriate functions.

1.5.1 Update the 1995 Olympic National Forest and State watershed analyses. Review management activities and short- and long-term goals for compatibility with bull trout recovery in the Forest Service watershed analyses for the South Fork Skokomish, Quinault, and Dungeness Rivers, and Matheny Creek. Review prescriptions in State

watershed analyses to ensure they are consistent with bull trout recovery, and reconvene prescription teams as needed to revise them.

1.5.2 Upgrade or decommission problem roads associated with legacy timber harvest in the uplands. Continue to mitigate for the legacy of intensive timber harvest and poor silvicultural and road construction practices in steep and highly erosive hill slopes. Past clear-cutting practices and high density road systems have resulted in mass wasting events and continued erosions and sediment introduction into bull trout habitats. Priority areas include upper Dungeness River and tributaries (Dungeness core area); South Fork Skokomish River and tributaries (Skokomish core area); and the middle Hoh River and tributaries (Hoh core area).

1.5.3 Minimize levels of effective impervious surface from development. Minimize the effects of impervious surfaces by protecting hydrologically mature forest cover to the maximum extent feasible, and by implementing other low impact development measures. Or, if lacking such forest condition, protect the opportunity to reestablish forest cover by minimizing amount of clearing, buildings and infrastructure. If reestablishment of forest cover is not possible due to existing high intensity development (*e.g.*, established areas of cities and unincorporated urban growth areas), then require highest levels of stormwater engineering and integrate low impact development measures (*e.g.*, impervious surface removal, roof top gardens) where possible. For rural areas (*i.e.*, lands not in cities or not within unincorporated areas with existing high density development) draining to bull trout foraging, migration and overwintering areas, maintain at least (but preferably more than) 65 percent hydrologically mature forest cover and no more (and preferably much less) than

10 percent effective impervious area. For cities and unincorporated areas with existing high density development, require the highest level of stormwater engineering available. For catchments draining to areas that are used for spawning and early rearing areas, developments should strive for zero percent effective impervious surfaces (*i.e.*, all stormwater should be treated on site to match predevelopment peaks, duration and quality), and at least (but preferably much more than) 65 percent forest cover. Generally, protected forest cover should be contiguous with riparian areas, steep slopes, aquifer recharge areas and wetlands. Accomplish these protections through appropriate zoning and development standards.

1.6 Identify impaired estuarine and nearshore habitats and implement actions to restore their appropriate function.

1.6.1 Implement projects that are key to restoring nearshore habitats. Key restoration projects for the Elwha, Skokomish, and Dungeness Rivers nearshore and estuary habitats include: providing or improving beach nourishment (*i.e.*, accumulation of sand and gravel materials for forming habitat); removing, moving, or modifying artificial structures (*e.g.*, bulkheads, riprap, dikes, tidegates); using alternative shoreline erosion and flooding protection measures that avoid or minimize impact to natural nearshore processes; and restoring estuaries and nearshore habitats such as eelgrass beds and kelp beds.

2. Prevent and reduce negative effects of nonnative fishes and other nonnative species on bull trout.

2.1 Develop, implement, and enforce public and private fish stocking policies to reduce stocking of nonnative fishes that affect bull trout.

2.1.1 Review effectiveness of current fish stocking policies. Eliminate planting nonnative fish species in areas draining into bull trout habitat. Reduce negative effects of fish stocking to bull trout and monitor for increased fishing pressure, alterations to prey base, competition, etc., that could impact bull trout.

2.2 Enforce policies for preventing illegal transport and introduction of nonnative fishes.

2.2.1 Review existing policies, including enforcement policies, for preventing illegal transport and introduction of nonnative fishes. Make necessary changes to improve effectiveness of existing policies and revise policies as necessary.

2.3 Increase public awareness about ecosystem concerns of illegal introductions of nonnative fishes.

2.3.1 Discourage unauthorized fish introductions. Implement educational effort describing the problems and consequences of unauthorized fish introductions, especially brook trout.

2.3.2 Develop a public information program about bull trout. Develop a public information program with broad emphasis on bull trout ecology and life history requirements and more specific focus on regionally or locally important recovery issues.

2.4 Evaluate biological, economic, and social effects of control of nonnative fishes.

2.4.1 Review existing protocols for eradicating, suppressing, or managing nonnative fish populations and implement protocols where needed. Conduct research and analysis of existing protocols to describe the most effective methods for managing, reducing, or eradicating nonnative fish populations from waters where they negatively impact bull trout recovery.

2.5 Implement control of nonnative fishes where found to be feasible and appropriate.

2.5.1 Determine distribution and abundance of nonnative fish (*i.e.* brook trout) and identify overlap with bull trout. Brook trout interbreed with bull trout and may outcompete them under certain conditions. Where information is lacking and the risk is high (*e.g.*, bull trout populations are depressed, habitat is degraded, and brook trout are present), conduct surveys in high lakes or tributaries to determine distribution of brook trout and degree of interbreeding, or potential for interbreeding, between bull trout and brook trout. Priority core areas include the Elwha, Dungeness, and Skokomish.

2.5.2 Identify brook trout and other nonnative fish populations impacting bull trout and evaluate feasability of their removal. Upon identification of streams with impacts from nonnative species, develop strategies for removal or reduction of nonnative fish that may compete directly for food and space with bull trout. Evaluate whether removal of the nonnative species is biologically feasible and whether removal is economically and socially supportable.

2.5.3 Remove established brook trout populations impacting bull trout. Where necessary and feasible, implement experimental removal of brook trout from selected streams and lakes. Priority areas include the Skokomish core area,

including Spider Lake, Brown Creek Beaver Pond, and Upper North Fork Skokomish River; Elwha core area, including Indian Creek; and the Quinault core area, including Enchanted Valley.

3. Establish fisheries management goals and objectives compatible with bull trout recovery and implement practices to achieve goals.

3.1 Develop and implement State and Tribal native fish management plans integrating adaptive research.

3.1.1 Integrate research and monitoring results into fish management plans and related salmonid information resources. Update native fish management plans [*e.g.*, bull trout/Dolly Varden Management Plan, Salmonid Stock Inventory (SaSI) appendix for bull trout and Dolly Varden, Wild Salmonid Policy, Washington Department of Fish and Wildlife's spawn survey database] with the latest results from bull trout research and monitoring, including distribution and population status. Develop and implement native fish management plans that emphasize timely integration of research results into management programs.

3.1.2 Protect remaining bull trout strongholds and native species complexes. Protect the integrity of areas with bull trout strongholds and intact native species assemblages (*e.g.*, upper Queets [Queets core area]; upper Hoh [Hoh core area]; upper Dungeness and Gray Wolf [Dungeness core area]; and upper Elwha [Elwha core area] Rivers.

3.1.3 Provide increased forage opportunities in freshwater. Establish improved forage opportunities by managing for increased salmon spawning escapement complementary to related habitat improvements to increase salmon productivity and abundance. Priority core areas include the Skokomish, Dungeness, and Elwha.

3.1.4 Increase biomass of marine forage base. Improve marine prey base (*e.g.*, surf smelt, sandlance, herring) known to be important to bull trout, through appropriate forage fish habitat protection and management measures.

3.2 Evaluate and prevent overharvest and incidental angling mortality of bull trout.

3.2.1 Develop reporting requirements for recreational, commercial, and Tribal fisheries to evaluate bull trout catch and incidental mortality during fisheries for other species. Collect information on magnitude and timing of bull trout caught and incidentally killed in State and Tribal fisheries in core areas and in foraging, migration, and overwintering habitat through expanded creel surveys and other reporting methods. Develop and recommend corrective action if necessary.

3.2.2 Evaluate and minimize incidental mortality of bull trout from recreational, gill-net, and other fisheries. Continue to develop and implement sport angling regulations and fisheries management plans, guidelines, and policies that minimize incidental mortality of bull trout in all waters, especially gill-net fisheries concentrated at the mouth of Olympic Peninsula rivers. Conduct research and develop more selective gear and seasons for salmon gill-net fisheries that will minimize incidental mortality of bull trout, such as adjusting net mesh sizes and/or duration of having nets out, placement of nets to minimize incidental capture of bull trout, and developing incentives to increase likelihood of bull trout being released alive from gill-net fisheries. It is important to provide extra monitoring of the Elwha River gill-net fishery following removal of the dams on the Elwha River and, if necessary, reduce capture of bull trout in the lower river.

3.2.3 Increase enforcement of angling regulations and target bull trout spawning and staging areas for extra enforcement efforts. Increase enforcement and posting of "closed waters" and bull trout informational signs in all readily accessible staging and spawning areas, and in areas with a known history of illegal harvest. Priority watersheds include the Dungeness, Hoh, and Skokomish (including Lake Cushman) core areas.

3.2.4 Implement angler awareness programs. Provide educational information to anglers and the public about bull trout identification, special regulations, methods to reduce hooking mortality, proper catch and release techniques, and the importance of bull trout and their habitat. Establish interpretive signs at all high-use fishing access points. Increase outreach efforts during the salmon and steelhead fishing season when and where bait is allowed for angling.

3.2.5 Solicit information from commercial fishing guides. Develop a reporting system and collect information on bull trout including catch per unit effort, observations, mortalities, or releases by recreational anglers.

3.3 Evaluate the potential effects of introduced fishes and associated sport fisheries on bull trout recovery and implement actions to minimize negative effects on bull trout.

3.3.1 Monitor and evaluate the effects of salmon and trout hatchery production, stocking, and associated fisheries on bull trout. Salmon and trout stocking or hatchery production occurs in all core areas. Evaluate effects to bull trout from competition, predation, disease, and related increased angling effort resulting from stocking salmon and trout.

3.3.2 Evaluate current and proposed fish stocking and reintroduction plans for Lake Cushman. Spawning habitat is limited upstream from Lake Cushman and increased stocking of salmon could cause an increase in salmon redds being imposed on bull trout redds. Prior to reintroduction and stocking of salmonids into Lake Cushman in the Skokomish core area, ensure there will not be significant negative impacts to bull trout from imposition of salmon redds on bull trout redds.

3.4 Evaluate effects of existing and proposed commercial and sport fishing regulations on bull trout.

3.4.1 Monitor and evaluate effects on bull trout from salmon and trout sport fisheries in Lake Cushman and Lake Kokanee. Make recommendations for regulation changes as needed to reduce significant impacts to bull trout from salmon and trout fisheries.

3.4.2 Identify important bull trout spawning and staging areas that may require special regulations. Identify spawning and staging areas in all core areas. Where populations are depressed or fishing pressures are heavy in bull trout spawning and staging locations, recommend special regulations. Recommend closures during bull trout staging and spawning on the South Fork Skokomish River from Pine Creek to Church Creek.

4. Characterize, conserve, and monitor genetic diversity and gene flow among local populations of bull trout.

4.1 Incorporate conservation of genetic and phenotypic attributes of bull trout into recovery and management plans.

4.1.1 Develop and implement a genetic study plan for future collection and analysis of genetic samples from local

populations. Use molecular analysis to delineate and describe the genetic population structure of bull trout populations in the Olympic Peninsula, both among core areas and among local populations within core areas. Incorporate this information into future management strategies. For example, genetic work for both local populations in the South Fork Skokomish and North Fork Skokomish Rivers should include an objective to validate the assumption that bull trout in these two areas comprise one core population. Another objective is to determine whether a viable population exists or if inbreeding depression has become a factor which could hinder recovery efforts.

4.1.2 Determine level of interaction between bull trout and Dolly Varden populations. Evaluate the level of interaction between sympatric (co-occurring) bull trout and Dolly Varden populations within core areas, and incorporate results in the management of both species. Focus efforts on Quinault and Dungeness core areas with known populations of both species.

4.2 Maintain existing opportunities for gene flow among bull trout populations.

4.2.1 Evaluate level of gene flow among core areas. Determine the level (frequency and amount) of gene flow among and within core areas that are linked by marine waters. Design and implement research efforts to determine the full extent of anadromous bull trout migration patterns and use between core areas; foraging, migration, and overwintering habitats; and marine areas.

4.2.2 Prevent establishment of barriers. Annually monitor "problem areas" where recreationists construct man-made check dams for mining activities or to create swimming

holes (*i.e.*, Skokomish and Hoh Rivers). These unauthorized dams may block fish passage if not removed. Coordinate with management agencies to retain existing connectivity as management actions are planned by preventing the establishment of barriers (*e.g.*, structural barriers or unsuitable habitat conditions) that may inhibit the movement of bull trout within the Olympic Peninsula Management Unit.

4.3 Develop genetic management plans and guidelines for appropriate use of transplantation and artificial propagation†.

4.3.1 If needed, establish genetic reserve protocols and standards for initiating, conducting, and evaluating captive propagation programs supported by the recovery plan. Although no core areas have been identified for propagation programs at this time, it may be necessary to artificially propagate bull trout to preserve fish that are likely to be extirpated or to conduct research. Protocols will be needed to standardize the process and prevent detrimental effects on the donor population and captive fish. If reestablishment of the Satsop River bull trout population is determined to be feasible, it may be necessary to develop a bull trout propagation program.

4.3.2 Establish protocols, standards, and guidelines for implementing and monitoring bull trout transplantation or stocking if necessary. Transplantation and stocking may be appropriate to conserve bull trout in some instances. Protocols are needed to determine when the activities are appropriate, how to conduct the activities, and how to evaluate their effectiveness.

5. Conduct research and monitoring to implement and evaluate bull trout recovery activities consistent with an adaptive management approach using feedback from implemented site-specific recovery actions.

5.1 Design and implement a standardized monitoring program to assess the effectiveness of recovery efforts affecting bull trout and their habitats.

5.1.1 Design and implement a population monitoring strategy for the Olympic Peninsula Management Unit. Design and implement a monitoring strategy taking into account the unique conditions (*e.g.*, glacial turbidity, larger spawning and rearing tributaries, anadromous life history forms, remoteness of spawning sites) in the Olympic Peninsula Management Unit, and revise the strategy as necessary according to the principles of conservation biology and adaptive management. Develop a range of alternative methods for assessing population abundance. Add a monitoring component for foraging, migration, and overwintering habitats (*e.g.*, Kalaloch Creek, Grays Harbor, etc.) that are identified as essential for recovery.

5.1.2 Implement a program to monitor and assess biological responses and changes in habitat from recovery actions. A standardized monitoring and assessment program needs to be developed and implemented to evaluate recovery criteria, assess and improve management actions, and ensure a coordinated strategy for the future of bull trout across their range within the coterminous United States. The program should include a protocol to reliably estimate bull trout abundance and population structure over time.

5.2 Conduct research to evaluate relationships among bull trout distribution and abundance, bull trout habitat, and recovery actions.

5.2.1 Investigate bull trout temporal and spatial movement to describe the distribution of juvenile, subadult, and adult bull trout in freshwater, estuarine, and nearshore habitats. Bull trout use of nearshore marine areas, estuaries, and

lower mainstem rivers and their associated tributaries is poorly understood; questions remain regarding bull trout habitat preferences (*e.g.,* depth, salinity, substrate), range of migration, and foraging requirements, amongst other factors, in these areas.

Continue implementation of existing bull trout population abundance and distribution studies, and initiate new studies. The highest priority is to identify and map all spawning and rearing areas within core areas. Efforts should initially focus on the Dungeness, Elwha, Hoh, Queets, and Quinault core areas. For anadromous and fluvial bull trout, continue to determine full extent of foraging, migration, and overwintering habitat. Use this information to update and revise recovery recommendations.

5.2.2 Conduct research to determine the cause and severity of low population numbers in the Skokomish core area. Several research projects have been identified that will more effectively define management actions necessary for recovery of this high risk core area, including determining the genetic structure of the population; developing an unbiased population size estimate; analyzing the influence of current and future hatchery planting of trout and salmon on bull trout and their prey base; investigating the effects of fluctuating lake levels and warm water at the North Fork Skokomish River inlet to Lake Cushman due to reservoir operations; and determining the extent of the threat of bull trout hybridization with brook trout in the South Fork Skokomish River.

5.2.3 Assess habitat capacity in the Satsop River and the potential for bull trout reestablishing a self-sustaining population. Bull trout historically occupied the West Fork Satsop and Canyon Rivers. The Satsop River is the only

tributary to the Chehalis River basin that is believed to have historically supported bull trout. No bull trout have been seen in the Satsop River since the 1970's and the species may be extirpated from that river.

5.2.4 Collect, compile, and analyze temperature data to determine bull trout distribution limits. Bull trout have very cold temperature requirements and temperature is believed to limit bull trout distribution. Temperature profiles may help to identify bull trout distribution limits.

5.2.5 Identify and assess the complete estuarine and marine forage base for bull trout. Conduct research to identify the complete forage base used by bull trout in estuarine and marine habitats. Assess the current condition of this forage base and evaluate its long-term role in recovery. This assessment should include identifying the forage species of greatest importance for various life stages and determining adequate distribution and necessary abundance levels of these forage species to support bull trout recovery.

5.2.6 Conduct migrational studies for the Olympic Peninsula Management Unit and coordinate with the Puget Sound Management Unit and British Columbia. Information collected from these efforts will provide a more complete understanding of adult bull trout habitat requirements, as well as the interrelationship of anadromous populations between the two management units and British Columbia.

5.3 Conduct evaluations of the adequacy and effectiveness of best management practices in maintaining or achieving habitat conditions conducive to bull trout recovery.

5.3.1 Develop and implement a sediment monitoring program. Develop a sediment monitoring program and focus collection of periodic sediment sampling in bull trout

spawning tributaries to determine the impact of management actions on delivery of fine sediments. Monitor all core areas where management activities may potentially release sediment into spawning, rearing, and migratory areas.

5.3.2 Develop and implement a temperature monitoring program. Develop a temperature monitoring program and collect periodic temperature samples in bull trout spawning tributaries to determine the impact of management actions on stream temperatures. Monitor all core areas where management activities may potentially increase temperature in spawning, rearing, and migratory areas.

5.3.3 Evaluate the adequacy and effectiveness of best management practices. Forest management on private lands is regulated by the Washington State Forest Practice Rules. The Natural Resource Conservation Service provides recommendations for agricultural management. Assess the adequacy of best management practices advocated by these and other entities, including keeping pesticides, sediment, and nutrients from entering streams, and recommend changes, as appropriate, to ensure recovery of bull trout..

5.4 Evaluate effects of diseases and parasites on bull trout, and develop and implement strategies to minimize negative effects.

5.4.1 Confirm the presence and potential extent of black spot disease in the Hoh River. Black spot disease is caused by an infestation of one or more species of trematode (a parasitic flatworm). Olympic National Park biologists may have detected black spot disease in bull trout in the Hoh River. Black spot disease can cause mortality, particularly when infestations are heavy. It is uncertain whether black

spot disease is a factor in the decline of bull trout in the Hoh River.

5.5 Develop and conduct research and monitoring studies to improve information concerning the distribution and status of bull trout.

5.5.1 Develop a predictive model of suitable habitat used by juvenile and resident bull trout. Development of a suitable habitat model for bull trout in the Olympic Peninsula rivers would help to refine prioritization of areas for surveys intended to detect new spawning or juvenile rearing sites. A suitable habitat model would also help to prioritize areas for recovery efforts.

5.5.2 Continue and expand studies on bull trout distribution, abundance, life histories, and factors (*e.g.*, habitat, demographics, etc.) affecting these characteristics. Bull trout are difficult to survey, and the Olympic Peninsula is especially difficult to survey due to limited access, glacial turbidity, and concurrent spawning by other salmonids. Additional studies are needed to better understand bull trout distribution, status, and limiting factors.

5.5.3 Locate additional spawning and early rearing sites. With increased survey efforts targeting bull trout, additional spawning sites and local populations will likely be identified within the management unit. The identification of additional local populations within the Olympic Peninsula Management Unit is a high priority.

5.6 Identify evaluations needed to improve understanding of relationships among genetic characteristics, phenotypic traits, and local populations of bull trout.

5.6.1 Determine the life history requirements and interactions of potentially overlapping resident and migratory bull trout

populations. The Olympic Peninsula has local populations that may contain both resident and migratory (anadromous, adfluvial, and fluvial) forms of bull trout. An understanding of the specific habitat requirements and interrelationship between resident and migratory forms will assist with monitoring and evaluating the recovery status of bull trout.

6. Use all available conservation programs and regulations to protect and conserve bull trout and bull trout habitats.

6.1 Use partnerships and collaborative processes to protect, maintain, and restore functioning core areas for bull trout.

6.1.1 Coordinate bull trout recovery with other listed salmonid species recovery efforts. The Olympic Peninsula Recovery Team will coordinate the implementation of bull trout recovery actions with Puget Sound Chinook and summer chum salmon recovery measures and other general salmon recovery efforts to avoid duplication of effort and maximize the use of available resources.

6.1.2 Ensure protection of the highest quality spawning and rearing habitats remaining within each core area through conservation plans, land purchases, and easements. Use partnerships to develop habitat conservation plans, conservation land purchases, and easements within core areas. Maintain and promote State and Federal land management programs that protect the best remaining spawning and rearing habitat within the management unit. Examples include Federal Wilderness, Wild and Scenic Rivers, land trusts, and State and Federal parks.

6.1.3. Develop collaborative approaches with landowners. Develop collaborative approaches with landowners, such as habitat conservation plans, conservation easements,

conservation land purchases, and habitat restoration projects, to implement conservation benefits to bull trout. Use partnerships and collaborative programs, such as Partners for Fish and Wildlife (U.S. Fish and Wildlife Service), to maintain and promote restoration of bull trout habitat within the management unit. The Simpson Timber Company Habitat Conservation Plan is an example of proactive conservation management on the Olympic Peninsula.

6.2 Use existing Federal authorities to conserve and restore bull trout.

6.2.1 Ensure adequate protection for bull trout at all life stages under Washington State Water Quality Standards. Ensure that new and existing water quality criteria are protective of all bull trout life stages and their prey base. Support development of research directed at evaluating exposure to contaminants and their effects on bull trout. Determine optimal temperature requirements for subadult and adult life stages and develop appropriate water quality standards to protect these life stages in the areas where they occur (*e.g.*, mainstem corridors, core area tributaries with anadromous use downstream of local populations, and independent tributaries used or potentially used by subadult and adult bull trout for foraging, migration, and holding).

6.3 Enforce existing Federal, State, and Tribal habitat protection standards and regulations and evaluate their effectiveness for bull trout conservation.

6.3.1 Support continued enforcement of Federal, State, and Tribal habitat protection standards and regulations. This includes standards and regulations in the Washington State Forest Practices Rules, Washington Department of Natural Resources Habitat Conservation Plan, Tribal Forest

Practice Rules, Shoreline Management Act, Growth Management Act, and Northwest Forest Plan.

7. Assess the implementation of bull trout recovery by management units and revise management unit recovery plans based on evaluations.

7.1 Convene annual meetings of each management unit recovery team to review progress on recovery plan implementation.

7.1.1 Generate progress reports on implementation of the bull trout recovery plan in the Olympic Peninsula Management Unit. Annual reviews are necessary to track progress in implementing the recovery plan. Annual reports can be used to identify successful approaches for implementing recovery actions and direct where efforts should be placed within management units.

7.2 Assess effectiveness of recovery efforts.

7.2.1 Develop and implement a standardized monitoring program to evaluate the effectiveness of recovery efforts (coordinate with Recovery Action 5.1). A standardized monitoring program is needed to evaluate achievement of recovery objectives and provide information to adaptively manage and improve recovery efforts.

7.3 Revise scope of recovery as suggested by new information.

7.3.1 Periodically assess progress toward recovery goals and assess recovery action priorities. Annually review progress toward population and abundance targets and recommend changes, as needed, to the recovery plan. In addition, review actions, action priorities, completed actions, budget, time frames, particular successes, and feasibility of actions identified for recovery in the Olympic Peninsula Management Unit.

IMPLEMENTATION SCHEDULE

Implementation schedules contained in each management unit chapter describe recovery action priorities, action numbers, action descriptions, duration of actions, potential or participating responsible parties, total estimated costs for the duration of the actions, cost estimates for the next 5 years, and comments. Those actions, when accomplished, will lead to recovery of bull trout in the Olympic Peninsula Management Unit, and ultimately to recovery of bull trout in the coterminous United States.

Parties with authority, responsibility, or expressed interest to implement a specific recovery action are identified in the implementation schedule. Listing a responsible party does not imply that prior approval has been given, nor does it require that party to participate or expend funds. However, willing participants will benefit by demonstrating that their budget submission or funding request is for a recovery action identified in an approved recovery plan and is therefore part of a coordinated effort to recover bull trout. In addition, section 7(a)(1) of the Endangered Species Act directs all Federal agencies to use their authorities to further the purposes of the Endangered Species Act by implementing programs for the conservation of threatened or endangered species.

In compliance with the U.S. Fish and Wildlife Service Endangered and Threatened Species Listing and Recovery Priority Guidelines, Recovery Plan Preparation and Implementation Priorities (48 FR 43103), the U.S. Fish and Wildlife Service has considered and adopted priorities and subpriorities that represent recovery goals for bull trout across their native range as well as those reflected in individual recovery chapters. The U.S. Fish and Wildlife Service also considered established conservation plans and the ongoing local, State and Federal planning processes to maintain consistency and integration with those efforts. Assigning priorities does not imply some recovery actions are of low importance as all recovery actions are important to achieve the recovery objectives. We further recognize lower priority actions may be implemented before higher priority actions because of the integration of bull trout recovery efforts with these existing plans and processes and/or the availability of funding opportunities. All recovery actions will have assigned priorities based on the following:

- Priority 1: All actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

- Priority 2: All actions that must be taken to prevent a significant decline in species population or habitat quality or to prevent some other significant negative effect short of extinction.

- Priority 3: All other actions necessary to provide for full recovery of the species.

Action Number and Action Description: Recovery actions as numbered in the recovery outline. Refer to the action narrative for action descriptions.

Action Duration: Expected number of years to complete the corresponding action. Study designs can incorporate more than one action that, when combined, can reduce the time needed for action completion.

Responsible or Participating Parties: The following organizations are those with responsibility or capability to fund, authorize, or carry out the corresponding action. Within the Implementation Schedule **bold** type indicates the agency or agencies that have the lead role for action implementation and coordination, though not necessarily sole responsibility. Additional identified agencies or parties (listed under "Other Agencies") are considered cooperators in conservation efforts. Identified parties include the following:

Federal Agencies

ACOE	U.S. Army Corps of Engineers
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
NMFS	National Marine Fisheries Service (NOAA Fisheries)
NRCS	Natural Resources Conservation Service
ONP	Olympic National Park
USFWS	U.S. Fish and Wildlife Service
USFS	U.S. Forest Service

State Agencies

WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WDOE	Washington Department of Ecology
WDOT	Washington Department of Transportation

Other Agencies

Tacoma Power	Public Utility
Counties	Jefferson, Clallam, Mason, and Grays Harbor County Governments
DR	Dungeness River Agricultural Water Users Association
QIN	Quinault Indian Nation
ST	Skokomish Tribe
JT	Jamestown S'Klallam Tribe
LET	Lower Elwha S'Klallam Tribe
Tribes	All of the above Tribes
SSPS	Shared Strategy for Puget Sound Watershed Groups
STC	Simpson Timber Company
RT	Rayonier Timber

Many of the actions necessary for bull trout recovery are related to restoration of the watershed(s) and as such are currently being implemented to some degree through existing programs and mandates. These actions are designated in the "comments" column as "ongoing." However, current implementation is typically being carried out at limited funding levels and/or in only a portion of the watershed and will need to be expanded to result in measurable gains toward the bull trout recovery goal and objectives. Most of these restoration actions are strongly interrelated, and separate cost estimates in the accompanying implementation schedule represent rough approximations.

Cost Estimates: Cost estimates are rough approximations and provided only for general guidance. Total costs are estimated for both the duration of the action, are itemized annually for the next 5 years, and includes estimates of expenditures

by local, Tribal, State, and Federal governments and by private business and individuals.

An asterisk (*) in the total cost column indicates ongoing actions that are currently being implemented as part of normal agency responsibilities under existing authorities. Because these actions are not being done specifically or solely for bull trout conservation, they are not included in the cost estimates. Some of these efforts may be occurring at reduced funding levels and/or in only a small portion of the watershed.

“TBD” in the total cost column indicates that the estimated costs for these actions are not determinable at this time. Input is requested to help develop reasonable cost estimates for these actions.

The symbol “‡” indicates costs are combined with or embedded within other related actions.

Implementation schedule for the draft bull trout recovery plan: Olympic Peninsula Management Unit											
Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	3.2.2	Evaluate and minimize incidental mortality of bull trout from recreational, gill-net, and other fisheries	25	**Tribes**, **ONP, USFWS**, **WDFW**	TBD						
1	3.3.2	Evaluate current and proposed fish stocking and reintroduction plans for Lake Cushman	4	**FERC**, ONP, **Tacoma**, **WDFW**, USFWS	40	10	10	10	10		
1	5.2.2	Conduct research to determine cause and severity of low population numbers in Skokomish core area	3	**ONP**,**Tacoma Power**, **USFS**, **WDFW**	180	60	60	60			
1	5.5.2	Continue and expand studies on bull trout distribution, abundance, life histories and factors affecting these characteristics	15	**ONP**, Tribes, **USFS**, **WDFW**, **USFWS**	140	40	40	20	20	20	Includes establishing index sites for surveying bull trout abundance
1	5.5.3	Locate additional spawning and early rearing sites	5	**ONP**, Tribes, **USFS**, **WDFW**, **USFWS**	300	60	60	60	60	60	Where appropriate use radio telemetry to track movements

* Ongoing actions currently being implemented as part of normal agency responsibilities; these actions are not included in the cost estimates since they are not being done specifically for bull trout conservation.

TBD Costs not determinable at this time; input is requested to help develop reasonable cost estimates for these actions.

‡ Costs are combined with or embedded within other related actions and are not itemized separately here.

Implementation schedule for the draft bull trout recovery plan: Olympic Peninsula Management Unit											
Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
1	6.1.2	Ensure protection of the highest quality spawning and rearing habitats remaining within each core area through measures including conservation land purchases and easements	25	ONP, **USFS**, **USFWS**, WDFW, **WDNR**	TBD						
1	6.2.1	Ensure adequate protection for bull trout at all life stages under Washington State Water Quality Standards	25	**Counties**, **EPA**, **FERC**, **ONP**, **Tribes**, **USFS**, USFWS, **WDOE**	*						
2	1.1.1	Identify and improve unstable or remove problem roads	25	**Counties**, **ONP**, **Tribes**, **USFS**, **WDNR**, **WDOT**	TBD						Complete ongoing surveys and inventories. Costs will be partially covered by ongoing actions
2	1.1.2	Improve routine road maintenance practices	25	**Counties**, **ONP**, **Tribes**, **USFS**, **WDNR**, **WDOT**	*						
2	1.1.3	Implement measures to restore natural thermal regime	25	**DR**, **FERC**, NRCS, Tribes, **USFS**	TBD						Costs will be partially covered by ongoing actions

* Ongoing actions currently being implemented as part of normal agency responsibilities; these actions are not included in the cost estimates since they are not being done specifically for bull trout conservation.

TBD Costs not determinable at this time; input is requested to help develop reasonable cost estimates for these actions.

‡ Costs are combined with or embedded within other related actions and are not itemized separately here.

Implementation schedule for the draft bull trout recovery plan: Olympic Peninsula Management Unit											
Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.1.6	Monitor water quality and meet water quality standards for temperature, nutrient loading, etc.	25	**WDOE**, **EPA**, USFS	TBD						
2	1.1.7	Identify, restore, and protect groundwater and hyporheic sources	25	DR, **DNR**, NRCS, **Tribes**, **USFS**	TBD						
2	1.1.8	Eliminate fine sediment sources from historical roads and railroads	20	**QIN**, **USFS**	TBD						Costs will be partially covered by ongoing actions
2	1.1.9	Adopt and implement a stormwater strategy for the Dungeness watershed, the lower Elwha watershed, and Hood Canal	5	**Counties**, **WDOE**	TBD						
2	1.2.1	Eliminate entrainment in diversions and ditches	25	**DR**, **NRCS**, **USFWS**	40	8	8	8	8	8	
2	1.2.2	Identify diversions that block fish passage and provide passage where feasible	25	**DR**, **FERC**, TG, USFWS, WDFW	‡						Costs partially covered by other actions (1.2.4, 1.2.5)
2	1.2.3	Eliminate culvert barriers	25	**Counties**, **ONP**, Tribes, **USFS**, **WDNR**, **WDOT**,	TBD						Total cost depends on number of culverts identified

* Ongoing actions currently being implemented as part of normal agency responsibilities; these actions are not included in the cost estimates since they are not being done specifically for bull trout conservation.

TBD Costs not determinable at this time; input is requested to help develop reasonable cost estimates for these actions.

‡ Costs are combined with or embedded within other related actions and are not itemized separately here.

Implementation schedule for the draft bull trout recovery plan: Olympic Peninsula Management Unit											
Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.2.5	Restore bull trout passage over dams and other related fish passage barriers	15	**FERC**, **ONP**, **USFWS**, **Tacoma**, **WDFW**	*						Cost will mostly be covered in salmon passage restoration projects. Total cost for Cushman Project upstream passage is estimated at 3 million. No estimate for downstream passage. Elwha Dam removal costs include complete ecosystem restoration and city water supply
2	1.2.6	Improve instream flows	25	**DR**, **FERC**, **Tacoma**, **WDOE**	TBD						
2	1.2.7	Improve the efficiency of the Dungeness watershed irrigation network	10	**DR**, **NRCS**, **USFWS**	TBD						
2	1.3.1	Restore and protect riparian areas	25	FERC, **Tribes**, **USFS**, **WDNR**, WDOT	TBD						

* Ongoing actions currently being implemented as part of normal agency responsibilities; these actions are not included in the cost estimates since they are not being done specifically for bull trout conservation.

TBD Costs not determinable at this time; input is requested to help develop reasonable cost estimates for these actions.

‡ Costs are combined with or embedded within other related actions and are not itemized separately here.

Implementation schedule for the draft bull trout recovery plan: Olympic Peninsula Management Unit											
Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.3.2	Identify, evaluate, and restore overwintering habitat in mainstem rivers and tributaries	25	**USFS**, **USFWS**, **WDFW**	TBD						Total cost depends on restoration needs
2	1.3.3	Identify, evaluate, and restore important bull trout freshwater foraging waters.	25	FERC, **ONP**, **Tribes**, **USFS**, **USFWS**, **WDFW**	TBD						Total cost partially depends on action 5.2.1
2	1.3.4	Reduce stream channel degradation and aggradation	25	**ACOE**, FERC, DR, ONP, STC, **USFS**, **WDNR**	‡						
2	1.3.5	Practice nonintrusive flood control and flood repair activities	25	**ACOE**, Counties, DR, FERC, **NRCS**	TBD						
2	1.3.6	Reduce impacts of development in streams, floodplains, and lake shores	25	**ACOE**, **Counties**, Tribes, WDFW	2000	400	400	400	400		Includes land purchase where appropriate
2	1.3.7	Reduce transportation corridor impacts on streams	25	**ACOE, Counties, DNR**, **ONP**, **QIN**, **USFS**, **WDOT**, WDFW	TBD						Costs will be partially covered by ongoing actions
2	1.3.9	Restore natural stream channel morphology	25	DR, **FERC**, **ONP**, **USFWS**	TBD						
2	1.3.10	Restore instream habitat	25	FERC, STC, **Tribes**, **USFS**, **WDNR**, WDFW	‡	200	200	200	100	100	Costs will be partially covered by other actions

* Ongoing actions currently being implemented as part of normal agency responsibilities; these actions are not included in the cost estimates since they are not being done specifically for bull trout conservation.

TBD Costs not determinable at this time; input is requested to help develop reasonable cost estimates for these actions.

‡ Costs are combined with or embedded within other related actions and are not itemized separately here.

Implementation schedule for the draft bull trout recovery plan: Olympic Peninsula Management Unit											
Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	1.3.12	Restore natural sediment routing and fluvial processes	25	Counties, **FERC**, **ONP**, **USFS**, WDOT, WDFW	‡						
2	1.3.13	Reduce impacts associated with recreational use of the rivers	25	**ONP**, **USFS**, WDFW	40	8	8	8	8	8	
2	1.4.1	Reduce reservoir operational impacts	25	**FERC**, **ONP**, **Tacoma**	‡						Costs will be partially covered by 1.2.4
2	1.4.2	Provide instream flow downstream from dams	25	**FERC**, **ONP**, **Tacoma**	TBD						Costs will be partially covered by 1.2.4
2	1.6.1	Implement projects that are key to restoring nearshore habitats	25	**ACOE**, **Counties**, **FERC**, ONP, Tribes, NMFS, USFS, USFWS	TBD						
2	2.3.2	Develop public information program about bull trout	5	**ONP**, **USFWS**, **WDFW**	*						
2	2.5.1	Determine distribution and abundance of nonnative fish (i.e., brook trout) and identify overlap with bull trout	5	**ONP**, **USFS**, **USFWS**, **WDFW**	100	20	20	20	20	20	Includes comprehensive surveys of lakes draining into bull trout streams

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Implementation schedule for the draft bull trout recovery plan: Olympic Peninsula Management Unit											
Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	2.5.2	Identify brook trout and other nonnative fish populations impacting bull trout and evaluate feasability of their removal	5	ONP, USFS, **WDFW**	20	4	4	4	4	4	Action follows completion of previous actions
2	2.5.3	Remove established brook trout populations impacting brook trout	25	ONP, USFS, **WDFW**	‡						Total cost depends on actions 2.5.2, 2.5.3
2	3.1.1	Integrate research and monitoring results into fish management plans	25	FERC, **ONP**, Tribes, USFS, USFWS, **WDFW**	‡						
2	3.1.2	Protect remaining bull trout strongholds and native species complexes	25	FERC, **ONP**, **USFS**, WDFW	TBD						
2	3.1.3	Provide increased forage opportunities in freshwater	25	**NOAA Fisheries, Tribes, WDFW**	TBD						
2	3.2.1	Develop reporting requirements for recreational, commercial, and Tribal fisheries to evaluate bull trout incidental mortality and catch during fisheries for other salmonid species	25	**Tribes**, **USFWS**, **WDFW**	150	20	20	20	20	20	
2	3.2.3	Increase enforcement of angling regulations and target bull trout spawning and staging areas for extra enforcement efforts	25	**ONP**, **USFS**, **WDFW**	500	100	100	100	100	100	At least one additional law enforcement officer

Implementation schedule for the draft bull trout recovery plan: Olympic Peninsula Management Unit											
Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	3.3.1	Monitor and evaluate effects on bull trout of salmon and trout hatchery production, stocking and associated fisheries	3	FERC, **ONP**, **WDFW**	50	20	15	15			
2	3.4.1	Monitor and evaluate effects on bull trout, salmon, and trout sport fisheries in Lake Cushman and Lake Kokanee	4	FERC, **ONP**, Tacoma, **WDFW**	100	25	25	25	25		Some costs may be covered under Action 3.3.1
2	3.4.2	Identify important bull trout spawning and staging areas that may require special regulations	25	**ONP**, **USFS**, **WDFW**	300	50	50	50	50	50	Total cost will depend on 5.5.1, 5.5.2
2	4.1.1	Develop and implement a genetic study plan for future collection and analysis of bull trout local populations	25	ONP, USFS, **USFWS**, WDFW	100	20	20	20	20	20	
2	4.2.2	Prevent establishment of barriers	25	**Counties**, NRCS, Tribes, **USFS**, **WDNR**, **WDOT**	TBD						

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‡ Costs are combined with or embedded within other related actions and are not itemized separately here.

Implementation schedule for the draft bull trout recovery plan: Olympic Peninsula Management Unit											
Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	4.3.1	If needed establish genetic reserve protocols and standards for initiating, conducting, and evaluating captive propagation programs supported by the recovery plan	25	USFS, **USFWS**, WDFW	TBD						This action is dependent on results of 5.2.4 and priority becomes 1 if reintroduction is feasible and necessary
2	4.3.2	Establish protocols, standards, and guidelines for implementing and monitoring bull trout transplantation or stocking if necessary	25	USFS, **USFWS**, WDFW	TBD						This action is dependent on results of 5.2.4, and becomes priority 1 if reintroduction is necessary
2	5.1.1	Design and implement a population monitoring strategy for the Olympic Peninsula Management Unit	5	ONP, Tribes, USFS, **USFWS**, **WDFW**	TBD						
2	5.1.2	Implement a program to monitor and assess biological responses and changes in habitat from recovery actions	25	FERC, ONP, **USFWS**, USFS	250	50	50	50	50	50	

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Implementation schedule for the draft bull trout recovery plan: Olympic Peninsula Management Unit											
Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	5.2.1	Investigate bull trout temporal and spatial movement to describe the distribution of juvenile, subadult, and adult bull trout in freshwater, estuarine, and nearshore habitats	5	**ONP**, **Tribes**, **USFS**, **USFWS**, **WDFW**	500	100	100	100	100	100	Ongoing. Some funding may be covered by other programs and Action 5.5.1
2	5.2.3	Assess capacity of habitat in the Satsop River and the potential for bull trout reestablishing a self-sustaining population	8	**USFS**, **USFWS**, WDFW	400	50	50	50	50		
2	5.2.4	Collect, compile and analyze temperature data to determine bull trout distribution limits	25	**Tribes**, **USFS**, **USFWS**, **WDOE**	350	75	75	75	75	50	Some costs may be covered under Action 1.1.8
2	5.2.5	Identify and assess complete estuarine and marine forage base for bull trout	2	**USFWS**, **USGS**, **WDFW**	200	100	100				
2	5.3.1	Develop and implement a sediment monitoring program	25	**Tribes**, **USFS**, **USFWS**, **WDNR**	*						
3	5.3.2	Develop and implement a temperature monitoring program	25	**EPA,** ONP, USFWS, USFS, WDNR, **WDOE**	*						

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Implementation schedule for the draft bull trout recovery plan: Olympic Peninsula Management Unit											
Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	5.5.1	Develop a predictive model of suitable habitat used to detect juvenile and resident bull trout	4	**WDNR,** USFS, **USFWS**	180		30	75	75		Some costs are covered by 5.5.1 and costs will be shared with the Puget Sound Management Unit
2	6.2.2	Fully implement the Clean Water Act	25	**Counties**, **EPA**, **FERC**, **ONP**, **ST**, **Tribes**, **USFS**, **WDOE**	*						
2	6.3.1	Support continued enforcement of Washington Forest Practices Rules, Washington Department of Natural Resources Habitat Conservation Plan, Tribal Forest Practice rules Shoreline Management Act, Growth Management Act, and Northwest Forest Plan	25	**Tribes**, **USFS**, **USFWS**, **WDNR**	*						
2	7.1.1	Generate progress reports on implementation of the bull trout recovery plan for the Olympic Peninsula Management Unit	25	ONP, Tribes, USFS, **USFWS**, WDFW	*						

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Implementation schedule for the draft bull trout recovery plan: Olympic Peninsula Management Unit											
Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
2	7.2.1	Develop and implement a standardized monitoring program to evaluate the effectiveness of recovery efforts	25	**USFWS**	*						
3	1.1.4	Assess and reduce water quality impacts from nutrient input from human activities	25	DR, **WDOE**, EPA, NRCS,	*						
3	1.1.5	Encourage the reestablishment of marine-derived nutrients	25	ONP, **USFS**, WDFW	150	30	30	30	30	30	Costs partially covered by other action 1.2.4
3	1.2.4	Eliminate or modify tidegate on the Skokomish River		**ACOE**	TBD						
3	1.3.8	Improve grazing practices	25	**NRCS**, **USFWS**,	200						
3	1.3.11	Protect riparian and channel habitat at campgrounds, trail systems, and recreation sites	25	**ONP**, **USFS**, WDNR	50	10	10	10	10	10	
3	1.3.14	Reduce riparian firewood harvest	25	ONP, **USFS**, WDNR	50	10	10	10	10	10	
3	1.5.1	Update the 1995 Olympic National Forest and State watershed analyses	25	**USFS**	*						

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Implementation schedule for the draft bull trout recovery plan: Olympic Peninsula Management Unit											
Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	1.5.2	Upgrade or decommission problem roads associated with legacy timber harvest in the upland	25	**QIN, USFS, WDNR**							
3	2.1.1	Review effectiveness of current fish stocking policies	2	**WDFW**	*						
3	2.2.1	Review existing policies, including enforcement policies, for preventing illegal transport and introduction of nonnative fishes	5	**WDFW**	*						
3	2.3.1	Discourage unauthorized fish introductions	25	ONP, USFWS, **WDFW**	*						
3	2.4.1	Review existing protocols for eradicating, suppressing, or managing nonnative fish populations and implement protocols where needed	2	**ONP**, **USFS**, **USFWS**, **WDFW**	*						
3	3.1.4	Increase biomass of marine forage base	25	**NOAA Fisheries, Tribes, WDFW**	*						
3	3.2.4	Implement angler education programs	25	**ONP**, **USFWS**, **WDFW**	100	20	20	20	20	20	

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Implementation schedule for the draft bull trout recovery plan: Olympic Peninsula Management Unit											
Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	3.2.5	Solicit information from commercial fishing guides	25	**ONP**, **USFWS**, **WDFW**	25	5	5	5	5	5	
3	4.1.2	Determine level of interaction between bull trout and Dolly Varden populations		ONP, **USFWS, WDFW**	100	20	20	20	20	20	Costs will be shared with Puget Sound bull trout management unit
3	4.2.1	Evaluate level of gene flow among core areas	5	ONP, **USFWS, WDFW**	TBD						
3	5.2.6	Conduct migrational studies for the Olympic Peninsula Management Unit and coordinate with the Puget Sound Management Unit and British Columbia	5	ONP, **USFWS**, USGS, WDFW	TBD						Costs will be shared with Puget Sound Management Unit
3	5.3.3	Evaluate the adequacy and effectiveness of best management practices	25	**USFWS**, **WDOE**	TBD						Ongoing. Some funding may be covered by other programs
3	5.4.1	Confirm presence and potential extent of black spot disease in the Hoh River	2	**ONP**, **USFWS**	80	40	40				

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Action priority	Action number	Action description	Action duration (years)	Responsible parties (Alphabetical)	Cost estimates ($1,000)						Comments
					Total cost	Year 1	Year 2	Year 3	Year 4	Year 5	
3	5.6.1	Determine the life history requirements and interactions of potentially overlapping resident and migratory bull trout populations	15	ONP, UFS, USFWS, WDFW	TBD						
3	6.1.1	Coordinate bull trout recovery with other listed salmonid species recovery efforts	25	NMFS, **SSPS**, Tribes, **USFWS**, WDFW	*						
3	6.1.3	Develop collaborative approaches with landowners	25	**NRCS**, SSPS, Tribes, **USFWS**	*						Costs depend on number of plans and projects
3	7.3.1	Periodically assess progress toward recovery goals and assess recovery action priorities	25	NRCS, **Olympic Peninsula Recovery Team**, SSPS, Tribes, USFS, **USFWS**, WDFW, WDNR, WDOE	*						
			TOTAL ESTIMATED COST		6,695						

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APPENDIX 1.
Olympic National Park: Angler effort and incidental catch records of bull trout in selected streams on the Olympic Peninsula.

Currently, there is very limited monitoring of Olympic Peninsula recreational fisheries and incidental bull trout caught and released. Washington Department of Fish and Wildlife conducts annual angler surveys and catch estimates in the Quillayute River system during the winter steelhead fishery, but the only documented char population in this watershed is a resident population of Dolly Varden upstream from Sol Duc Falls. There is limited information regarding catches of bull trout caught in several rivers originating in Olympic National Park. National Park Service rangers, volunteers, and fisheries technicians have surveyed anglers during various seasons on the Queets, Hoh, Quinault, Skokomish, and Elwha Rivers to gather basic information regarding species composition and catch rates (Table 6). All of these surveys occurred during or after 1994 when bull trout harvest was prohibited so species composition was based on the angler's ability to identify the fish. No estimates of total effort are available for most of these angler surveys and only catch per hour estimates of bull trout caught incidentally are available.

While seasonal data is lacking for most of these rivers, it is available for the Queets River where catches of bull trout per hour have been the highest during the summer months. The higher capture rates in the summer may be due to upstream migration of mature adults toward suspected staging and spawning areas in the upper watershed.

Catch per hour is relatively low in each of the reported rivers with the highest incidental capture rates recorded in the North Fork Skokomish River. Catch per hour estimates for the Hoh, Quinault, North Fork Skokomish, and lower Elwha Rivers were collected during the summers of 1994 and 1995. Queets River catches of bull trout caught in the summer were collected during 1994 and 1995 and fall catch data were collected in 1994, 1995, and 1998. Winter catch information for the Queets was gathered during the 1994–1995, 1995–1996, 1999–2000, 2000–2001, and 2001–2002 seasons. Summer, fall, and

winter surveys were conducted from June–August, September–November, and December–April, respectively.

Total effort and catches of bull trout can be estimated from angler surveys conducted by Olympic National Park on the Queets and Salmon Rivers. The Salmon River is a principal tributary to the Queets and supports substantial returns of hatchery Chinook salmon, coho salmon, and steelhead. Total incidental catch of bull trout during the Queets winter steelhead fishery has been estimated from angler surveys within the park since 1999. This fishery occurs from December – April 15 although restrictions have been implemented in some years to ensure adequate escapement of wild steelhead. The survey period usually begins in early to mid-December and extends through March or April, depending on availability of survey personnel and emergency closures. Incidental catches of bull trout during this fishery ranged from 9 during the 1999–2000 season to 86 in the 2001–2002 season (Table 7), which closed early (March 15) due to an emergency closure directed toward winter steelhead. All the bull trout reported in these surveys were released by the angler, and it was assumed that they could distinguish between the salmonid species present in the river. It was also assumed that anglers cooperated by reporting char when contacted by the surveyors.

Table 7. Mean catch of bull trout per hour as reported by anglers in several Olympic Peninsula Rivers.

River	Summer	Fall	Winter
Queets within Olympic National Park	.011	.004	.002
Hoh from the mouth to the Hoh	.008	—	—
Quinault upstream from Lake Quinault	.006	—	—
North Fork Skokomish River	.018	—	—
Lower Elwha downstream from Elwha	.010	—	—

Catches of bull trout in the Queets and Salmon Rivers (Table 8) showed little correlation to estimated total boat and bank angling effort (Table 9). Fishing effort on the Queets River varies widely between years based primarily on river conditions; the river is typically high and turbid for much of December and January. Fishing effort also varies with catch rates/abundance of winter steelhead, gear and harvest restrictions in effect, and fishing opportunities on other rivers in Puget Sound and the Washington Coast. Total estimated effort on the Queets River during the 1999–2000 through 2001–2002 seasons varied considerably, with high effort during the 1999–2000 season and lower levels of effort during the 2000–2001 and 2001–2002 seasons. The lower levels of effort in the latter two seasons may have been due in part to emergency restrictions on the harvest of steelhead.

Table 8. Estimated total catch of bull trout from the Queets and Salmon Rivers during the winter steelhead season of December–April, 1999–2000 through 2001–2002 seasons.

Season	December	January	February	March	April	Total Estimated Catch
1999–2000	0	9	0	0	No survey data	9
2000–2001	0[1]	25	13	7	0	45
2001–2002	20[2]	20	29	17[3]	River closed	86

[1] Angler surveys began on December 16, does not include the period December 1–15.
[2] Angler surveys began on December 16, does not include the period December 1–15.
[3] Angler surveys began on December 16, does not include the period December 1–15.

Table 9. Estimated hours of fishing by recreational anglers, Queets and Salmon Rivers during the 1999–2000 through 2001–2002 winter steelhead seasons.

Season	December	January	February	March	April	Total Angler Hours
1999–2000	5,144	5,644	19,787	11,980	No survey data	42,555
2000–2001	2,020[1]	4,343	5,928	4,992	2,264	19,547
2001–2002	6,516[2]	3,121	3,467	3,3272[3]	River closed	16,431

[1] Angler surveys began on December 16, does not include the period December 1–15.
[2] Angler surveys began on December 16, does not include the period December 1–15.
[3] Angler surveys began on December 16, does not include the period December 1–15.

Sport fishing effort on coastal rivers, such as the Hoh and Queets River systems, have increased steadily over the past 10 years, although, effort on these rivers is largely a function of river conditions and availability of harvestable salmon and steelhead. It is also influenced by fishing restrictions in Puget Sound rivers. The number of fishing days during the winter steelhead season are often limited by rainfall and river flows. But, when the rivers are fishable, sport angling effort is generally high. Fishing effort on systems like the Dungeness and North Fork Skokomish Rivers is very low due to the very restrictive sport regulations in place. Most of these rivers, streams, and lakes on the Olympic Peninsula remain open to fishing for salmon, steelhead, and trout for much the year but current tackle restrictions are much more conservative than they were prior to 1994. Bait fishing is prohibited in all bull trout waters in the interior of Olympic National Park during the summer months when incidental catches may be highest. Most of these upper river areas retain bait bans throughout the entire year and many also restrict tackle to single barbless hooks.

APPENDIX 2.

State of Washington's 303(d) list for the Olympic Peninsula Management Unit, (as per section 303(d) of the Clean Water Act, 33 USC 1251 *et seq*.).

(Based on the Washington Department of Ecology 303(d) List website: http://www.ecy.wa.gov/programs/wq/303d/1998/1998_by_wrias.html. Locations of listed stream segments are not identified on the 303 (d) list.)

Within a local population	Stream Name	1996 List	1998 List	Pollutant(s)
Skokomish Core Area				
	Skokomish River	no	no	pH
	Skokomish River	yes	yes	Fecal coliform
No	Skobob Creek	no	no	Temperature
	Skokomish River	no	no	Dissolved oxygen
	Skokomish River, North Fork	no	yes	Temperature
	Skokomish River, North Fork	yes	yes	Instream flow
Dungeness Core Area				
	Dungeness River	yes	yes	Instream flow
	Dungeness River	no	no	Thallium
No	Matriotti Creek	yes	yes	Fecal coliform
Elwha Core Area				
	Elwha River	yes	yes	Temperature
	Elwha River	yes	yes	PCB-1254
No	Port Angeles Harbor	no	yes	Total PCBs

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Within a local population	Stream Name	1996 List	1998 List	Pollutant(s)
No	Port Angeles Harbor	no	no	pH
No	Port Angeles Harbor	yes	yes	Dissolved oxygen
Hoh Core Area				
No	Canyon Creek	yes	yes	Temperature
No	Line Creek	yes	yes	Temperature
No	Maple Creek	yes	yes	Temperature
No	Mosquito Creek	no	no	Temperature
No	Nolan Creek	yes	yes	Temperature
No	Owl Creek	yes	yes	Temperature
No	Rock Creek	yes	yes	Temperature
No	Willoughby Creek	yes	yes	Temperature
No	Winfield Creek	yes	yes	Temperature
No	Coal Creek	no	yes	Temperature
No	Alder Creek	yes	yes	Temperature

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(Based on the Washington Department of Ecology 303(d) List website: http://www.ecy.wa.gov/programs/wq/303d/1998/1998_by_wrias.html. Locations of listed stream segments are not identified on the 303 (d) list.)

Within a local population	Stream Name	1996 List	1998 List	Pollutant(s)
No	Anderson Creek	yes	yes	Temperature
Queets Core Area				
	Queets River	no	no	Dissolved oxygen
	Queets River	no	no	Temperature
	Queets River	no	no	Fecal coliform
Quinault Core Area				
	Quinault River	no	yes	Temperature
No	Red Creek	no	no	Temperature
Hood Canal and Independent Tributaries foraging, migration, overwintering habitat				
No	Hood Canal (South)	yes	yes	Fecal coliform
Strait of Juan de Fuca and Independent Tributaries foraging, migration, overwintering habitat				
No	Sequim Bay	no	no	Ammonia-N
No	Sequim Bay	yes	yes	Dissolved oxygen
No	Sequim Bay	yes	yes	pH
No	Sequim Bay	no	yes	Fecal coliform

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(Based on the Washington Department of Ecology 303(d) List website: http://www.ecy.wa.gov/programs/wq/303d/1998/1998_by_wrias.html. Locations of listed stream segments are not identified on the 303 (d) list.)

Within a local population	Stream Name	1996 List	1998 List	Pollutant(s)
No	Sequim Bay	no	no	Temperature
No	Bell Creek	yes	yes	Fecal coliform
No	Strait of Juan De Fuca (East)	no	no	Dissolved oxygen
No	Strait of Juan De Fuca (East)	no	no	Dioxin
Pacific Ocean and Coastal Streams foraging, migration, overwintering habitat				
No	Joe Creek	yes	yes	Dissolved oxygen
No	Joe Creek	yes	yes	Fecal coliform
No	Kalaloch Creek (W.F.)	yes	yes	Temperature
Lower Chehalis River/Grays Harbor foraging, migration, overwintering habitat				
No	Grays Harbor (Inner)	yes	yes	Fecal coliform
No	Grays Harbor (Inner)	no	no	Temperature

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(Based on the Washington Department of Ecology 303(d) List website: http://www.ecy.wa.gov/programs/wq/303d/1998/1998_by_wrias.html. Locations of listed stream segments are not identified on the 303 (d) list.)

Within a local population	Stream Name	1996 List	1998 List	Pollutant(s)
No	Grays Harbor (Inner)	no	no	Water column biossay
No	Grays Harbor (Inner)	no	no	pH
No	Grays Harbor (Inner)	no	no	Dioxin
No	Grays Harbor (Outer)	no	no	Temperature
No	Grays Harbor (Outer)	no	no	Dissolved oxygen
No	Grays Harbor (Outer)	yes	yes	Fecal coliform
No	Humptulips River	yes	yes	Temperature
No	Chehalis River	yes	yes	Fecal coliform
No	Chehalis River	yes	yes	Temperature

APPENDIX 3.

Linkage between recovery actions and threats ("Reasons for Decline") for bull trout in the Olympic Peninsula Management Unit.

Action Number	Criteria Number(s)	Threats						
		Dams	Forest Management Practices	Agricultural Practices	Transportation Networks	Residential Development and Urbanization	Fisheries Management	Isolation and Habitat Fragmentation
1.1.1	1, 2, 3		X		X	X		X
1.1.2	1, 2, 3		X		X	X		
1.1.3	1, 2, 3		X	X	X			X
1.1.4	1, 2, 3		X		X	X		
1.1.5	1, 2, 3	X	X	X		X	X	
1.1.6	1, 2, 3	X	X	X	X	X		
1.1.7	1, 2, 3		X	X	X	X		
1.1.8	1, 2, 3		X		X			
1.1.9	1, 2, 3				X	X		
1.1.10	1, 2, 3					X		
1.1.11	1, 2, 3	X		X	X	X		
1.2.1	4	X		X			X	X
1.2.2	4	X		X			X	X
1.2.3	4		X		X			X
1.2.4	4	X					X	X
1.2.5	4	X					X	X

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Action Number	Criteria Number(s)	Threats						
		Dams	Forest Management Practices	Agricultural Practices	Transportation Networks	Residential Development and Urbanization	Fisheries Management	Isolation and Habitat Fragmentation
1.2.6	4	X		X				X
1.2.7	4			X				X
1.3.1	1, 2, 3		X	X	X	X		X
1.3.2	1, 2, 3		X	X	X	X		
1.3.3	1, 2, 3	X	X	X	X	X		
1.3.4	1, 2, 3		X	X	X	X		X
1.3.5	1, 2, 3			X	X	X		
1.3.6	1, 2, 3				X	X		
1.3.7	1, 2, 3				X	X		
1.3.8	1, 2, 3			X				
1.3.9	1, 2, 3	X	X	X	X	X		
1.3.10	1, 2, 3		X	X	X	X		
1.3.11	1, 2, 3		X					
1.3.12	1, 2, 3		X	X	X	X		
1.3.13	1, 2, 3		X				X	
1.3.14	1, 2, 3		X					
1.4.1	1, 2, 3	X						
1.4.2	1, 2, 3	X						

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Action Number	Criteria Number(s)	Threats						
		Dams	Forest Management Practices	Agricultural Practices	Transportation Networks	Residential Development and Urbanization	Fisheries Management	Isolation and Habitat Fragmentation
1.5.1	1, 2, 3		X					
1.5.2	1, 2, 3		X					
1.6.1	1, 2, 3	X	X		X	X		
2.1.1	1, 2, 3						X	
2.2.1	1, 2, 3						X	
2.3.1	1, 2, 3						X	
2.3.2	1, 2, 3						X	
2.4.1	1, 2, 3						X	
2.5.1	1, 2, 3						X	
2.5.2	1, 2, 3						X	
2.5.3	1, 2, 3						X	
3.1.1	1, 2, 3						X	
3.1.2	1, 2, 3						X	
3.2.1	1, 2, 3						X	
3.2.2	1, 2, 3						X	
3.2.3	1, 2, 3						X	
3.2.4	1, 2, 3						X	
3.2.5	1, 2, 3						X	

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Linkage between recovery actions and threats ("Reasons for Decline") for bull trout in the Olympic Peninsula Management Unit.

Action Number	Criteria Number(s)	Threats						
		Dams	Forest Management Practices	Agricultural Practices	Transportation Networks	Residential Development and Urbanization	Fisheries Management	Isolation and Habitat Fragmentation
3.3.1	1, 2, 3						X	
3.3.2	1, 2, 3						X	
3.4.1	1, 2, 3						X	
3.4.2	1, 2, 3						X	
4.1.1	1, 2, 3, 4						X	X
4.2.1	1, 2, 3, 4						X	X
4.3.1	1, 2, 3, 4						X	X
4.3.2	1, 2, 3, 4						X	X
5.1.1	1, 2, 3						X	
5.1.2	1, 2, 3	X	X	X	X	X	X	
5.2.1	1, 2, 3						X	
5.2.2	1, 2, 3	X					X	X
5.2.3	1, 2, 3, 4						X	X
5.2.4	1, 2, 3		X	X		X	X	
5.2.5	1, 2, 3						X	
5.3.1	1, 2, 3		X	X		X		
5.3.2	1, 2, 3	X	X	X				
5.3.3	1, 2, 3		X	X				

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Linkage between recovery actions and threats ("Reasons for Decline") for bull trout in the Olympic Peninsula Management Unit.

Action Number	Criteria Number(s)	Threats						
		Dams	Forest Management Practices	Agricultural Practices	Transportation Networks	Residential Development and Urbanization	Fisheries Management	Isolation and Habitat Fragmentation
5.4.1	1, 2, 3						X	
5.5.1	1, 2, 3		X				X	
5.5.2	1, 2, 3						X	
5.5.3	1, 2, 3						X	
5.6.1	1, 2, 3, 4						X	X
6.1.1	1, 2, 3, 4	X	X	X	X	X		X
6.2.1	1, 2, 3	X	X	X	X	X		X
6.2.2	1, 2, 3, 4		X	X	X	X		
6.3.1	1, 2, 3, 4		X	X	X	X		X
7.1.1	1, 2, 3, 4	X	X	X	X	X	X	X
7.2.1	1, 2, 3	X	X	X	X	X	X	

APPENDIX 4.
Effective Population Size and Recovery Planning

Effective population size provides a standardized measure of the amount of genetic variation that is likely to be transmitted between generations within a population. Effective population size is a theoretical concept that allows one to predict potential future losses of genetic variation within a population due to small population size and genetic drift. Individuals within populations with very small effective population sizes are also subject to *inbreeding depression* because most individuals within small populations share one or more immediate ancestors (parents, grandparents, etc.) after only a few generations and will be closely related.

A number of factors affect the effective population size of a species. For example, unequal sex ratios can significantly affect effective population size because male and female adults of the parent generation must each contribute 50 percent of the genes to the progeny generation regardless of their relative numbers. Hence, effective population size will be lower than the summed census number of both sexes, and will also be less than four times as large as the number of adults of the less common sex. For example, a population derived from one male and three females would have an effective population size of three; a population derived from one male and an infinite number of females would have an effective population size of four (Crow and Kimura 1970). The latter population would experience the same amount of genetic drift as a population derived from only two males and two females. Similarly, populations with high fluctuations in abundance over time (or generations) will have an effective population size that is approximated by the harmonic mean of the effective population sizes of each generation. This harmonic mean will be influenced significantly by the generation with the lowest effective population size because that generation represents the “bottleneck” through which all genetic variation in future generations must pass.

It is relatively easy to relate effective population size to theoretical losses of genetic variation in future generations and, thus, provide conservation guidelines for effective population size. Based on standardized theoretical equations (Crow and Kimura 1970), the following guidelines have been

established for maintaining minimum effective population sizes for conservation purposes:

- Effective Population Size > 50 to prevent inbreeding depression and a potential decrease in viability or reproductive fitness of a population (Franklin 1980);

- Effective Population Size > 500 to minimize loss of genetic variation due to genetic drift and maintain constant genetic variance within a population resulting from a balance between loss of variance due to genetic drift and an increase in variance due to new mutations or gene migration (Franklin 1980; Soulé 1980; Lande 1988);

- Effective Population Size > 5,000 to maintain constant variance for quasi-neutral, genetic variation that can serve as a reservoir for future adaptations in response to natural selection and changing environmental conditions (Lande 1995). The rationale here is that the effective population size needs to be large enough to minimize genetic drift and the potential loss of genetic material that may confer a slight, selective advantage under existing or future environmental conditions.

In contrast to establishing conservation guidelines for effective population size, it is much more difficult to quantitatively relate the breeding structure of a species and census numbers of populations to effective population size so that the 50/500/5000 guidelines can be applied at the appropriate scale. The longevity, life histories, and structure of individual breeding units (*i.e., local populations*) must be understood sufficiently to relate the number of observed adults within a particular population (and in a particular generation) to a genetic *effective number of breeders*. Conceptually, this latter quantity will be similar to effective population size in the classical, textbook sense. Second, it is necessary to understand the amount of gene flow among geographically adjacent breeding units (*e.g.*, bull trout reproducing in adjacent tributaries to a river) so that, over multiple-generation time-scales, effective breeding numbers at the local

population level can be considered part of a larger *metapopulation* with respect to applying the 50/500/5000 guidelines. For example, very small amounts of gene flow may not be sufficient to increase the effective number of breeders within a given local population above effective population equal to 50. However, in a combination of such populations that experience gene flow between them, effective breeding numbers for the metapopulation may be greater than 500. In this latter situation, one would predict significant genetic variation among breeding units and comparatively small amounts of genetic variation within individual breeding units, but the combination (or metapopulation) as a whole could potentially retain significant amounts of genetic variation over time. The key to understanding the evolutionary and conservation implications of such a breeding structure is knowing whether the individual breeding units, or local populations, are completely isolated reproductively or whether some gene flow does indeed occur, thus allowing genetic material to be reintroduced if lost from a particular population.

The effective population size > 5,000 rule derived by Lande (1995) relates largely to future evolutionary potential. Hence, the scale for its application are expected, in most cases, to be much larger than the spatial and temporal scales at which one applies the “50/500" rules. For example, the effective population size > 50 and effective population size > 500 guidelines may be most applicable on time scales encompassing 1 to 5 and 5 to 50 generations, respectively: at least two generations are necessary to produce “inbred” individuals after a population has gone through a major population bottleneck (*i.e.*, effective population size < 50), and a substantially greater number of generations are usually necessary for genetic drift to be significant (*i.e.*, when effective population size < 500). On the other hand, the effective population size > 5,000 guideline relates to the evolutionary persistence of a species over some defined geographic area such that, if extinction does occur, recolonization from elsewhere is precluded geographically or is unlikely to occur over microevolutionary time scales (*e.g.*, 50 or more generations).

Rieman and Allendorf (2001) have performed computer simulations of bull trout populations to understand the relationship between the observed number of adults, or spawners, within a local population and effective population size. Their best estimate of effective population size is 0.5 to 1.0 times the mean

number of adult fish spawning annually. This translates into maintaining between 50 and 100 spawners per year to minimize potential inbreeding effects within local populations. The spatial scale for such a local population would encompass all adult fish with approximately equal probability of interbreeding amongst themselves within a single year or generation. One would expect such a population to include very few immigrants from another population or breeding unit. Between 500 and 1,000 spawners per year would be needed to maintain genetic variation and minimize the deleterious effects of drift. The appropriate spatial for maintaining genetic variation for bull trout would be most frequently applied at the core area level.

APPENDIX 5.
Federal Legislation, Activities and Guidelines Affecting Bull Trout Recovery

Endangered Species Act. Bull trout in the coterminous United States occur on lands administered by the Federal Government (*e.g.*, Bureau of Land Management, Forest Service, and National Park Service), various State-owned properties, and private and Tribal lands. The majority of bull trout spawning and rearing habitat occurs on Federal lands. Federal agency actions that occur on Federal lands or elsewhere with Federal funds or authorization may require consultation under the Endangered Species Act (16 USC 1531 *et seq*.). These actions include U.S. Army Corps of Engineers involvement in projects such as the construction of roads and bridges, the permitting of wetland filling and dredging projects subject to section 404 of the Clean Water Act (33 USC 1251 *et seq*.), construction, maintenance, and operation of dams and hydroelectric plants; Federal Energy Regulatory Commission-licensed hydropower projects authorized under the Federal Power Act (16 USC 791a *et seq*.); Forest Service and Bureau of Land Management timber, grazing, and recreation management activities; Environmental Protection Agency-authorized discharges under the National Pollutant Discharge Elimination System of the Clean Water Act; U.S. Housing and Urban Development projects; U.S. Bureau of Reclamation projects; and National Park Service activities. Because there are various policies, directives, and regulations providing management direction to Federal agencies and opportunities to conserve bull trout, *e.g.*, roadless area conservation on Forest Service lands (66 FR 3244), we provide the following types of activities as examples.

Bull Trout Interim Conservation Guidance. The purpose of the Bull Trout Interim Conservation Guidance is to provide U.S. Fish and Wildlife Service biologists with a tool that is useful in conducting Endangered Species Act activities, including section 7 consultations, negotiating Habitat Conservation Plans that culminate in the issuance of section 10(a)(1)(B)-incidental take permits (see section 10(a)(1) discussion below), issuing recovery permits, and providing technical assistance in forest practice rule development and other interagency bull trout conservation and recovery efforts. This document is not intended to supersede any biological opinion that has been completed for Federal agency

actions. Rather, it should be used as another tool to assist in consultation on those actions.

PACFISH/INFISH. Land management plans for the Bureau of Land Management and Forest Service lands within the range of bull trout have been amended by the Interim Strategy for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of California (PACFISH; USDA and USDI 1995a) and the Interim Strategy for Managing Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, Western Montana and Portions of Nevada (INFISH; USDA and USDI 1995b). PACFISH, developed by the Bureau of Land Management and Forest Service, is intended to be an ecosystem-based, aquatic habitat and riparian-area management strategy for Pacific salmon, steelhead, and sea-run cutthroat trout habitat on lands administered by the two agencies that are outside the area subject to the Northwest Forest Plan. INFISH was developed by the Forest Service to provide an interim strategy for inland native fish in areas outside those where PACFISH and the Northwest Forest Plan apply. We issued a programmatic non-jeopardy biological opinion on land and resource management plans of the Bureau of Land Management and Forest Service, as amended by PACFISH and INFISH, for the Klamath and Columbia River population segments of bull trout that endorsed implementation of additional commitments made by the two agencies (USFWS 1998a). The commitments included habitat restoration and improvement; standards and guidelines of PACFISH and INFISH; evaluation of key and priority watershed networks; completion of watershed analysis and monitoring; establishing goals for long-term conservation and recovery; and conducting section 7 consultation at the watershed level. The biological opinion also identified additional actions to help ensure conservation of bull trout. Consultations for site-specific actions are continuing, as are consultations for land and resource management plans in other bull trout population segments.

In December, 1998, the regional executives for the U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Forest Service and Bureau of Land Management chartered The Interagency Implementation Team. This Team is integral to the implementation of PACFISH and INFISH, under the direction of the regional executives, and is responsible for coordinating implementation of the biological opinions on the effects of the aquatic conservation strategies on listed

salmon, steelhead and bull trout. The Team has directed the development of a PACFISH/INFISH Monitoring Task Team to develop a monitoring program for tracking implementation and effectiveness of PACFISH/INFISH.

Northwest Forest Plan. On April 13, 1994, the Secretaries of the Department of Agriculture and the Department of the Interior adopted the Northwest Forest Plan for management of late-successional forests within the range of the northern spotted owl (USDA 1994a, b). This plan contains objectives, standards, and guidelines to provide for a functional late-successional and old-growth forest ecosystem. Included in the plan is an Aquatic Conservation Strategy involving riparian reserves, key watersheds, watershed analysis, and habitat restoration. We issued a programmatic non-jeopardy biological opinion on the plan for the Coastal-Puget Sound, Columbia River, and Klamath River population segments of bull trout (USFWS 2000). The biological opinion also identified additional actions to be taken by the Federal land managers to help ensure conservation of bull trout. These actions included clearly documenting that proposed actions are consistent with the aquatic conservation strategy objectives, developing and implementing guidance for reducing effects of road management programs on bull trout, and responding quickly to mining notices on lands administered by the Bureau of Land Management in order to advise operators how to prevent adverse effects to bull trout. Consultations for site-specific actions are ongoing.

Section 10(a)(1) Permits. Permits, authorized under section 10(a)(1) of the Endangered Species Act, may be issued to carry out otherwise prohibited activities involving endangered and threatened wildlife under certain circumstances. Permits are available for scientific purposes to enhance the propagation or survival of a species and for incidental "take" (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect a listed species) in connection with otherwise lawful activities. Private landowners seeking permits for incidental take offer a means of protecting bull trout habitat through the voluntary development of Habitat Conservation Plans and Safe Harbor Agreements.

Habitat Conservation Plans. Incidental take permits are required when non-Federal activities will result in "take" of threatened or endangered species. A

habitat conservation plan must accompany an application for an incidental take permit. The purpose of the Habitat Conservation Planning process is to ensure there is adequate minimization and mitigation of effects from the authorized incidental take. The purpose of the incidental take permit is to authorize the incidental take of a listed species.

As one example, the Plum Creek Timber Company developed a Habitat Conservation Plan with us addressing bull trout and other native salmonids occurring on over 688,500 hectares (1.7 million acres) of corporate lands, primarily in the Columbia River basin. The majority of the land under consideration occurs in Montana (87 percent) with the remainder in Idaho and Washington. Because silvicultural activities, logging road construction and maintenance, and open range cattle grazing by the Plum Creek Timber Company may result in harm to bull trout, seven categories of conservation commitments were included in the Habitat Conservation Plan. The seven categories are: (1) road management, (2) riparian management, (3) livestock grazing, (4) land-use planning, (5) legacy management and other restoration opportunities, (6) administration and implementation measures, and (7) monitoring and adaptive management. The conservation benefits of activities in the seven categories include reducing sediment delivery to streams from roads and grazing, increasing canopy cover in riparian areas, restoring stream bank integrity and overall habitat complexity, and providing fish passage at road culverts and water diversion structures.

In Washington, the Washington Department of Natural Resources developed a Habitat Conservation Plan that was adopted on January 1, 1999. The plan covers the approximately 647,500 hectares (1.6 million acres) of forested State trust lands that lie within the range of the northern spotted owl. The Habitat Conservation Plan contains riparian conservation strategies that were designed to protect salmonid and riparian species for lands west of the Cascade Mountains crest. It includes a streamside no-harvest buffer strategy, a minimal-harvest area for ecosystem restoration, and a low-harvest area for selective removal of single trees or groups of trees and thinning and salvage operations. In addition to riparian buffers, road management standards were developed to ensure that mass-wasting (erosion and landslides) is not artificially accelerated and that sediment delivery remains near natural levels. The Habitat Conservation Plan

also includes monitoring and adaptive management components. The minimization and mitigation actions of the plan will address habitat requirements of bull trout and cumulatively will reduce the adverse effects to bull trout in comparison to previous forest management practices (USFWS 1998b).

Safe Harbor Agreements. Safe Harbor Agreements between the U.S. Fish and Wildlife Service and non-Federal landowners are another voluntary mechanism to encourage conservation of listed species and authorize incidental take permits. In general, these agreements provide (1) conservation benefits for listed species that would otherwise not occur except for the agreement, and (2) Endangered Species Act regulatory assurances to the landowner through a section 10 permit. Safe Harbor Agreements are intended for landowners who have few or no listed species (or listed species' suitable habitat) on their property, but who would be willing to manage their property in such a way that listed species may increase on their lands, as long as they are able to conduct their intended land-use activities. An example of how Safe Harbor Agreements may be used to further bull trout conservation can be found with fish passage barriers in streams. If a landowner owns a stream with a fish passage barrier that prevents access to their property by bull trout, they may be unwilling to remove the barrier, and thereby allow access by bull trout, for fear of the "take" prohibitions under section 9 of the Endangered Species Act and potential restrictions on land-use activities. Under a Safe Harbor Agreement, the landowner would agree to removal of the barrier, allow bull trout access to their property, and the landowner and U.S. Fish and Wildlife Service would negotiate other conservation measures necessary to ensure suitable bull trout habitat conditions are maintained on the property while allowing the landowner's land-use activities to occur. The landowner would receive a section 10 permit authorizing incidental take of bull trout consistent with the agreed upon conservation measures in the Safe Harbor Agreement. Safe Harbor Agreements for bull trout may be developed in the future.

Clean Water Act. The Clean Water Act (33 USC 1251 *et seq*.) provides some regulatory mechanisms for protection and restoration of water quality in waters that support bull trout. Under sections 303 and 304, states or the Environmental Protection Agency set water quality standards, which combine designated beneficial uses and criteria established to protect uses. States or the Environmental Protection Agency designate water bodies that are failing water

quality standards as water quality limited under section 303(d) (*e.g.*, Appendix 1), and are required to develop management plans. Management plans include total maximum daily loads with implementation plans that define site-specific actions and timelines for meeting water quality goals (65 FR 43586). The total maximum daily loads assess and allocate all the point and nonpoint sources of pollutants within a watershed. Best management practices are used with total maximum daily loads to address nonpoint sources of pollution, such as mining, forestry, and agriculture. Regulatory authority to enforce the best management practices, however, varies among the states. The U.S. Environmental Protection Agency requests that states give higher priority to polluted waters that are sources of drinking water or support listed species, when developing total maximum daily loads and implementation plans (65 FR 43586).

In accordance with section 319 of the Clean Water Act, states also develop programs to address nonpoint sources of pollution such as agriculture, forestry, and mining. The effectiveness of controlling water pollution from these activities has been mixed. The State of Washington monitored the effectiveness of riparian prescriptions under past forest practices regulations in meeting water quality temperature criteria for streams on forest lands and concluded that regulations for stream shading were inadequate to meet criteria (Sullivan *et al.* 1990).

Northwest Power Planning Council Fish and Wildlife Program. Congress, through the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (16 USC 839), directed the Northwest Power Planning Council to develop a Fish and Wildlife Program. The program is intended to give the citizens of Idaho, Montana, Oregon, and Washington a stronger voice in the future of electricity generated by the Federal hydropower dams in the Columbia River basin and fish and wildlife affected by the dams and their operation.

One of the Northwest Power Planning Council's major responsibilities is to develop a program to protect and rebuild fish and wildlife populations affected by hydropower development in the Columbia River basin. State, Tribal, and local governments often work closely with the Northwest Power Planning Council as it develops power and fish and wildlife plans. The Bonneville Power Administration provides funding for implementation of the Council's Fish and

Wildlife Program. In 2000, the Council amended its Fish and Wildlife Program to include development of subbasin plans. Subbasin planning, beginning in 2002, is a means for identifying projects that will be funded to protect, mitigate, and enhance the Columbia River basin's fish and wildlife resources. These plans are viewed as crucial efforts for implementing the Endangered Species Act responsibilities of the Bonneville Power Administration, U.S. Army Corps of Engineers, and the Bureau of Reclamation in the Columbia River basin.

The primary objective of subbasin planning is to develop a unifying element for implementation of the Northwest Power Planning Council's Fish and Wildlife Program. It will also assist in the implementation of Endangered Species Act recovery activities. One of the goals of the subbasin planning process is to provide specific products that can be integrated directly into the Endangered Species Act recovery planning process. We will provide specific geographic area bull trout recovery plan to the applicable subbasin planning teams that have the responsibility for developing subbasin plans.

Federal Caucus Fish and Wildlife Plan. The Federal Caucus is a group of nine Federal agencies, formed as a result of the Federal Columbia Power System Biological Opinion, that have responsibilities for natural resources affecting species listed under the Endangered Species Act. The agencies are the National Marine Fisheries Service, U.S. Fish and Wildlife Service, Bureau of Reclamation, Bonneville Power Administration, U.S. Army Corps of Engineers, Bureau of Indian Affairs, Forest Service, Bureau of Land Management, and Environmental Protection Agency. The Federal Caucus has drafted a basinwide recovery strategy for listed anadromous fish in the Columbia River basin which addresses management of habitat, hatcheries, harvest, and hydropower. This recovery strategy, titled 'The Conservation of Columbia River Basin Fish: Final Basin-Wide Recovery Strategy,' will provide the framework for development of recovery plans for individual species and for effects determinations for actions under consultation. As recovery plans for individual species are developed following the basinwide strategy, and measures to address biological needs of all stages of the life cycle are implemented, conditions for listed aquatic species are expected to improve sufficiently to provide for their survival and recovery. The Basin-Wide Salmon Recovery Strategy concludes that restoring tributary and

estuary habitat is key to recovering listed fish. Actions focus on restoring tributary (both Federal and non-Federal), mainstem, and estuary habitat.

For long-term actions, the Basin-Wide Salmon Recovery Strategy endorses the Northwest Power Planning Council strategy of conducting subbasin assessments and developing subbasin plans and prioritizing actions based on those plans. Once the assessments are complete, the Federal agencies will participate with State agencies, local governments, Tribes and stakeholders to develop subbasin plans. Draft subbasin summaries were used extensively in the preparation of the bull trout recovery plan.

While the salmon recovery framework has only recently been adopted, and thus the benefits of this recovery framework have not yet been realized, we envision significant improvements in habitat conditions for listed salmonids as recovery activities are implemented. Because bull trout often use the same areas, we expect bull trout to similarly benefit from improved habitat conditions.

U.S. Department of Agriculture. The U.S. Department of Agriculture offers landowners financial, technical, and educational assistance to implement conservation practices on privately owned land. Using this help, farmers and ranchers apply practices that reduce soil erosion, improve water quality, and enhance forest land, wetlands, grazing lands, and wildlife habitat. U.S. Department of Agriculture assistance also helps individuals and committees restore after floods, fires, or other natural disasters.

This assistance is provided to landowners via Farm Bill programs administered by the U.S. Department of Agriculture, Farm Service Agency and the Natural Resources Conservation Service. The implementation of practices associated with these programs may improve conditions for bull trout. In particular, the Conservation Reserve Enhancement Program is targeted to areas in Oregon and Washington where other listed fish occur and may provide direct benefits to bull trout.

The Conservation Reserve Easement Program is an addition to the Conservation Reserve Program. A Conservation Reserve Enhancement Program for the State of Oregon and the State of Washington was approved October 1998,

in a Memorandum of Agreements between the United States Department of Agriculture, the Commodity Credit Corporation and the states of Oregon and Washington. The Conservation Reserve Easement Program is a partnership between Federal agencies, State agencies, and private landowners. Land enrolled in this program is removed from production and grazing, under 10 to 15 year contracts. In return, landowners receive annual rental, incentive, maintenance and cost share payments.

In Washington, eligible stream designations were originally based on spawning habitat for stocks designated as critical or depressed under the 1993 Salmon and Steelhead Stock Inventory. Approximately 9,656 kilometers (6,000 miles) of eligible streams were included. Recent changes allow for the nomination of additional stream segments where riparian habitat is a significant limiting factor, and a new cap of 16,093 kilometers (10,000 miles) of eligible streams.

Other Farm Bill programs encourage farmers to convert highly erodible cropland or other environmentally sensitive acreage to native vegetative cover, provide incentives for landowners to restore function and value to degraded wetlands on a long-term or permanent basis, assist landowners with habitat restoration and management activities specifically targeting fish and wildlife (including threatened and endangered species), provide technical and financial assistance to farmers and ranchers that face threats to soil, water, and related natural resources, and support forest management practices on privately owned, nonindustrial forest lands.

APPENDIX 6.
Glossary of Technical Terms

Adaptive trait
Characteristics that improve an individual's survival and fitness.

Adfluvial bull trout
Bull trout that migrate from tributary streams to a lake or reservoir to mature (one of three migratory bull trout life history forms, the others being anadromous and fluvial forms). Adfluvial bull trout return to a tributary to spawn..

Age class
A group of individuals of a species that have the same age, *e.g.*, 1 year old, 2 year old, etc.

Aggradation/Aggrading stream
A stream that is actively building up its channel or floodplain by being supplied with more bedload than it is capable of transporting.

Alluvial
Pertaining to or composed of silts and clays (usually) deposited by a stream or flowing water. Alluvial deposits may occur after a flood event.

Alluvial fan
A sedimentary deposit located at a topographic break such as the base of a mountain front, escarpment, or valley side, that is composed of streamflow and/or debris flow sediments and that has the shape of a fan, either fully or partially extended.

Anadromous (fish)
A fish that is born in fresh water, migrates to the ocean to grow and live as an adult, and then returns to freshwater to spawn (reproduce). Anadramous bull trout are one of three migratory bull trout life history forms, the others being adfluvial and fluvial forms.

Artificial propagation
The use of artificial procedures to spawn adult fish and raise the resulting progeny in fresh water for release into the natural environment, either directly from the hatchery or by transfer into another area.

Bedload
Sediment particles that are moved on or immediately above the stream bed, such as the larger heavier particles (gravel, boulders) rolled along the bottom; the part of the load that is not continuously in suspension.

Braided channel/Braided stream
A stream that forms an interlacing network of branching and recombining channels separated by islands and channel bars. Generally a sign of stream disequilibrium resulting from transportation of excessive rock and sediment from upstream areas and characteristic of an aggrading stream in a wide channel on a floodplain.

Bycatch
Organisms that are incidentally caught in the process of hunting or fishing for another target species.

Bypass system (fish)
Structure in a dam that provides a route for fish to move through or around a dam without going through the turbines.

Canopy cover (of a stream)
Vegetation projecting over a stream, including crown cover (generally more that 1 meter [3.3 feet] above the water surface) and overhang cover (less than 1 meter [3.3 feet] above the water).

Channel morphology
The physical dimension, shape, form, pattern, profile, and structure of a stream channel.

Channel stability
The ability of a stream, over time and in the present climate, to transport the sediment and flows produced by its watershed in such a manner that the stream maintains its dimension, pattern, and profile without either aggrading or degrading.

Channelization
The straightening and deepening of a stream channel to permit the water to move faster, to reduce flooding, or to drain wetlands.

Char (*also* charr)
A fish belonging to the genus *Salvelinus* and related to both the trout and salmon. The bull trout, Dolly Varden trout, and the Mackinaw trout (or lake trout) are all members of the char family. Char live in the icy waters (both fresh and marine) of North America and Europe.

Complex interacting groups
Multiple local populations within a geographic area having connectivity that allows for individuals from each of these populations the opportunity to interact with one another.

Connectivity (stream)
Suitable stream conditions that allow fish and other aquatic organisms to move freely upstream and downstream. Habitat linkages that connect to other habitat areas.

Core area
The combination of core habitat (*i.e.*, habitat that could supply all elements for the long-term security of bull trout) and a core population (a group of one or more local bull trout populations that exist within core habitat) constitutes the basic unit on which to gauge recovery. Core areas require both habitat and bull trout to function, and the number (replication) and characteristics of local populations inhabiting a core area provide a relative indication of the core area's likelihood to persist. In most cases, core areas are presumed to reflect the metapopulation structure of bull trout (see "metapopulation," below).

Core habitat
Habitat that encompasses spawning and rearing habitat (resident populations), with the addition of foraging, migrating, and overwintering habitat if the population includes migratory fish. Core habitat is defined as habitat that contains, or if restored would contain, all of the essential physical elements to provide for the security of and allow for the full expression of life history forms of one or more local populations of bull trout. Core habitat may include currently unoccupied habitat if that habitat contains essential elements for bull trout to persist or is deemed critical to recovery.

Core population
A group of one or more bull trout local populations that exist within core habitat.

Deposition (stream)
The settlement or accumulation of material out of the water column and onto the stream bed. Occurs when the energy of flowing water is unable to support the load of suspended sediment.

Discharge (stream)
With reference to stream flow, the quantity of water that passes a given point in a measured unit of time, such as cubic meters per second or, often, cubic feet per second.

Distinct population segment
A distinct population segment is a population subset of a vertebrate species or subspecies that meets the tests of discreteness and significance under the joint policy of the U.S. Fish and Wildlife Service and National Marine Fisheries Service (61 FR 4722). A distinct population segment designated as such under a regulatory rulemaking is a "listable entity" under the Endangered Species Act.

Effective population size
The number of breeding individuals that would give rise to the same amount of random genetic drift as the actual population, if ideal conditions held. Generally speaking, the effective population size is a measure of the number of individuals that are contributing to future generations from a genetic perspective. The

effective population size is often significantly smaller than the census population size.

Entrainment
Process by which aquatic organisms are pulled through a diversion, turbine, spillway, or other device.

Extirpation
The elimination of a species from a particular local area.

Fine sediment (fines)
Sediment with particle sizes of 2.0 millimeters (0.08 inch) or less, including sand, silt, and clay.

Fish ladder
A device to help fish swim around a dam.

Floodplain
Adjacent to stream channels, areas that are typified by flat ground and are periodically submerged by floodwater.

Flow regime
The quantity, frequency and seasonal nature of water flow.

Fluvial bull trout
Bull trout that migrate from tributary streams to larger rivers to mature (one of three migratory bull trout life history forms, the others being adfluvial and anadromous forms). Fluvial bull trout migrate to tributaries to spawn.

Foraging, migration, and overwintering habitat (bull trout)
Relatively large streams and mainstem rivers, lakes or reservoirs, estuaries, and nearshore environments, where subadult and adult migratory bull trout forage, migrate, mature, or overwinter. This habitat is typically downstream from spawning and rearing habitat and contains all the physical elements to meet critical overwintering, spawning migration, and subadult and adult rearing needs. Although use of foraging, migrating, and overwintering habitat by bull trout may

be seasonal or very brief (as in some migratory corridors), it is a critical habitat component.

Fry
Young, recently hatched fish.

Head-cut
Upstream migration or deepening of a stream channel that results from cutting (*i.e.*, erosion) of the streambank by high water velocities (Armantrout 1998).

Headwaters
The source of a stream. Headwater streams are the small swales, creeks, and streams that are the origin of most rivers. These small streams join together to form larger streams and rivers or run directly into larger streams and lakes.

Hooking mortality
Death of a fish from stress or injury after it is hooked and reeled in, then released back to the water.

Hybridization
Any crossing of individuals of different genetic composition, typically different species, that result in hybrid offspring.

Hyporheic zone
Area of saturated sediment and gravel beneath and beside streams and rivers where groundwater and surface water mix. Water movement is mainly in a downstream direction**.**

Legacy effects
Impacts from past activities (usually a land use) that continue to affect a stream or watershed in the present day.

Local population
A group of bull trout that spawn within a particular stream or portion of a stream system. Multiple local populations may exist within a core area. A local population is considered to be the smallest group of fish that is known to

represent an interacting reproductive unit. For most waters where specific information is lacking, a local population may be represented by a single headwater tributary or complex of headwater tributaries. Gene flow may occur between local populations (*e.g.*, those within a core population), but is assumed to be infrequent compared with that among individuals within a local population.

Management unit (bull trout)
A subset of a listed entity that is defined by the U.S. Fish and Wildlife Service for administrative and management purposes, usually to manage recovery for a species that is broadly distributed and that may experience a wide range of threats and management authorities across its distribution. In the case of bull trout, the distinct population segment was further subdivided into management units based on several factors, including biological and genetic considerations, political boundaries, and ongoing conservation efforts. In some instances, management unit boundaries were modified to maximize efficiency of established watershed groups, encompass areas of common threats, or accommodate other logistic concerns. Biologically, management units are considered groupings of bull trout for which gene flow was historically or is currently possible. Management units are utilized to more effectively target specific recovery actions, but management units are not eligible for reclassification or delisting separately from the listed entity.

Mass wasting
Loss of large amounts of material in a short period of time, *i.e.*, downward movement of land mass material or landslide.

Metapopulation
There are several different models of metapopulation dynamics, but in general a metapopulation refers to a population structure in which subpopulations may be distributed across the landscape in a patchy or semi-isolated pattern, but connectivity between these subpopulations is critical for maintaining the metapopulation as a whole. In the case of bull trout, we assumed that core areas represent the functional equivalent of a metapopulation structure for bull trout, and that the local populations within these core areas are interconnected by occasional dispersal between them and therefore share some genetic characteristics.

Migratory corridor (bull trout)
Stream reaches used by bull trout to move between habitats. A section of river or stream used by fish to access upstream spawning areas or downstream lake environments. *See also* foraging, migration, and overwinter habitat.

Migratory life history form (bull trout)
Bull trout that migrate from spawning and rearing habitat to lakes or reservoirs (adfluvial), larger rivers (fluvial), or the ocean (anadromous) to grow and mature.

Moraine
An accumulation of earth and stones carried and eventually deposited by a glacier.

Mysid
A small, shrimp-like crustacean of the order Mysidacea. Mysids are found primarily in marine waters, but there are some freshwater forms as well.

Nonnative species
Species not indigenous to an area, such as brook trout in the western United States.

Otolith(s)
Otoliths are compact, mineralized structures suspended in the interior of the inner ear of teleost (bony) fishes. Important in orientation and locomotion, otoliths grow in concentric layers (similar to the growth rings of a tree) reflecting the daily growth of the fish and essentially record the environmental conditions encountered by the individual.

Peak flow (stream)
Greatest stream discharge recorded over a specified period of time, usually a year, but often a season.

Piscivorous
Describes fish that prey on other fish for food.

Potential local population
A local population that does not currently exist, but that could exist, if spawning and rearing habitat or connectivity were restored in that area, and contribute to recovery in a known or suspected unoccupied area. Alternatively, a potential local population may be a population that is suspected to exist, but that has not yet been adequately documented.

Recovery team (bull trout)
A team of people with technical expertise in various aspects of bull trout biology from Federal and State agencies, Tribes, private industry, and interest groups responsible for assisting in the development of the bull trout recovery plan for a given management unit.

Redd
A nest constructed by female fish of salmonid species in streambed gravels where eggs are deposited and fertilization occurs. Redds can usually be distinguished in the streambed gravel by a cleared depression, and an associated mound of gravel directly downstream.

Refounding
Reestablishment of a species into previously occupied habitat.

Resident life history form (bull trout)
Bull trout that do not migrate, but that reside in tributary streams their entire lives (one of four bull trout life history forms; the other three forms are all migratory [adfluvial, fluvial, or anadromous]).

Revetment
A facing, usually of stone or concrete, that supports an embankment.

Riparian area
Area with distinctive soils and vegetation between a stream or other body of water and the adjacent upland. It includes wetlands and those portions of floodplains and valley bottoms that support riparian vegetation.

Riprap
A common type of streambank armoring or protection, formed of rocks of various sizes.

Salmonid
Fish of the family Salmonidae, including trout, salmon, chars, grayling, and whitefish. In general usage, the term most often refers to salmon, trout, and chars.

Scour
Concentrated erosive action by stream water, as on the outside curve of a bend; also, a place in a streambed swept clear by a swift current.

Seral stage
A developmental stage in ecological succession, not including the climax community.

Skidding
A logging term for pulling or dragging cut trees through the forest to a loading site.

Smolt
A juvenile salmon or steelhead migrating to the ocean and undergoing physiological changes to adapt its body from a freshwater environment to a saltwater environment.

Spawning and rearing habitat/streams/areas (bull trout)
Stream reaches and the associated watershed areas that provide all habitat components necessary for spawning and juvenile rearing for a local bull trout population. Spawning and rearing habitat generally supports multiple year classes of juveniles of resident or migratory fish and may also support subadults and adults from local populations of resident bull trout.

Spawning escapement
The number of adult fish from a specific population that survive spawning migrations and enter spawning grounds.

Spillway
The part of a dam that allows high water to flow (spill) over the dam.

Splash dam
A temporary or permanent structure in a stream channel that was historically used to store logs and water until sufficient water was retained from precipitation and runoff to transport the logs downstream when the splash dam was opened.

Stock
The fish spawning in a particular lake or stream(s) at a particular season, which to a substantial degree do not interbreed with any group spawning in a different place, or in the same place at a different season. A group of fish belonging to the same population, spawning in a particular stream in a particular season.

Subbasin
The surface area of a watershed drained by a tributary to a larger stream that is bounded by ridges or other hydrologic divides and is located within the larger watershed drained by the larger stream (Armantrout 1998).

Sublittoral
The marine zone extending from the depth of the intertidal (littoral) to the outer edge of the continental shelf at a depth of about 200 meters.

Subpopulation (bull trout)
A reproductively isolated group of bull trout spawning within a particular area of a river system; the basic unit of analysis used in the initial listing of bull trout, but not used extensively in the recovery plan.

Subwatershed
Topographic perimeter of the catchment area of a stream tributary.

Take
Activities that harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or attempt to engage in any such conduct to a listed (Endangered Species Act) species.

Thermocline
In the summer, the layer of water in a lake which exhibits the greatest unit decrease in temperature per unit increase in depth; the transitional zone between the upper, warmer layer of water (epilimnion) and the cooler, denser, lower layer (hypolimnion) of water.

Toe slope
The base of a slope along a bank or other geographic feature where a gentle incline changes abruptly to a steeper gradient (Armantrout 1998).

Transplantation
Moving wild fish from one stream system to another without the use of artificial propagation.

Trap and haul
An operation to physically move migratory fish upstream around a barrier that does not have a fish ladder or other passage to allow spawning. Fish are generally captured in a trap and transported by truck to a release site upstream of the barrier.

Watershed
The area of land from which rainfall (and/or snow melt) drains into a stream or other water body. Watersheds are also sometimes referred to as drainage basins or drainage areas. Ridges of higher ground generally form the boundaries between watersheds. At these boundaries, rain falling on one side flows toward the low point of one watershed, while rain falling on the other side of the boundary flows toward the low point of a different watershed.

Woody debris

Woody material such as trees and shrubs; includes all parts of a tree such as root system, bowl, and limbs. Large woody debris refers to the woody material whose smallest diameter is greater than 10 centimeters (4 inches) and whose length is greater than 1 meter (3.3 feet).